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ARBOREAL TADPOLES.

BY W. J. HOLLAND.[1]

ON the 20th of July, while engaged at Nikko in collecting entomological specimens, I entered a small field enclosed by a low stone wall near the banks of the Daiya-gawa in the lower part of Iri-machi, not far from the famous red bridge. The field had evidently once been used for growing tea, but had lain neglected for several years, and was partly overgrown by weeds and tangled bushes, among which were a good many willows some of them already twenty or more feet in height. While beating this growth for beetles I observed, pendant from the branches of a thrifty clump of willows, several objects which at first reminded me of hornets' nests save that they were of a light reddish color. They hung over a pool of stagnant water about twenty feet in diameter situated upon what I took to have formerly been the site of a house. A nearer inspection of these objects convinced me that they were not infested by aculeate insects and that in attempting to get at them I would not run any painful risk save that of being mired in the stagnant pool. I observed that one of the objects seemed to be in an apparently decomposing condition, saturated with moisture, and dropping to pieces. Long filaments of slimy froth-like matter were hanging from it, and clinging in streamers from the twigs of the trees just below. I also ob-

[1]Naturalist of the U. S. Eclipse Expedition to Japan, 1887. Extract from the Report of the Exped'tion made by Prof. D. P. Todd and presented by Prof. Simon Newcomb, at the meeting of the National Academy of Sciences, April 19, 1889.

served a great many black ants traveling out upon the willow twigs, and a few of them apparently entangled upon the surface of the mass which was falling to pieces. With some difficulty and with the help of a coolie, I succeeded in drawing the most perfect of these objects within reach, and by cutting the willow branches getting it entire to the ground.

I was quite confident that it was of insect origin and my curiosity to ascertain its nature and structure was great. I asked the coolie what it was. His reply was the usual "Wakarimasen," *Anglice* "don't know." The outer surface was dry and had the appearance of very thin brown wafer. At the places where the willow twigs passed in and out of the mass there were projecting points and at the apices of these in several instances there was an exudation of glairy matter, which had the appearance of very fine soap suds. All over the exterior were the bodies and wings of small insects which had evidently been entrapped in the mass when it had been soft. A few ants and flies were struggling in the bubbly, vesicular scum, which was freshest near one or two of the branches at their insertion into the mass, as I have described. Taking my pocket knife I opened the curious structure and found its interior to be composed of a mass of tough, glairy, froth, resembling the white of an egg that has been well beaten, but of a dirty, yellowish brown color. What, however, was my amazement to find scattered through it, and wriggling about hither and thither, a colony of tadpoles, of which I counted twenty-two. They were black in color with white bellies, exceedingly lively, and apparently, very much at home. Here and there in the mass were the remains of insects, principally legs and wings and the chitinous outer coverings of the abdominal and thoracic segments of black ants.

Having no means of preserving the tadpoles with me, as I had hastily gone to Nikko with Professor Todd, leaving my alcohol behind me at Tokio, I resolved to let the best of the remaining two nests remain until the morning of the 22d, when I resolved to secure it, and if possible take it with me to Tokio. I however took down the largest of the two remain-

ing nests, which was already beginning to drop to pieces. In this were also a few tadpoles. A diligent search of the pool failed to reveal any tadpoles in its shallow, miry depths. The next day I revisited the spot. The nest I had designated for myself still remained undisturbed upon the branches, but was drenched with the passing showers. It rains at Nikko in July every day beginning about noon. I made a rough sketch of the object. The following day I repaired to the spot to get the nest, and also armed with a large jar kindly provided by Dr. Whitney, into which to put the tadpoles, and scum should it come to pieces. Unfortunately during the night the elements had made partial wreck of the coveted prize. It was broken in places and hanging down in wet streamers. I took a number of these with the enclosed tadpoles and put them into the jar. But soon they dried up. All that I had left to me was a mass of partly desiccated scum, with some dead tadpoles in it. I allowing this to dry out hard and in this state brought it home to America.

Upon examination I find that the tadpoles have been preserved in the mass in a highly desiccated condition. When alive they were about three quarters of an inch in length. In their dried form they are, it is needless to say, much smaller. By immersing in a mixture of glycerine and water, I have succeeded in partially restoring the form to one or two of them.

These with the bulk of the dried froth I have sent to Prof. Edw. D. Cope, of Philadelphia, who assures me that the phenomenon I have observed is one of much novelty.[1]

Chiromantis guineënsis is said to deposit its eggs upon the branches of trees on the margin of streams in Western Tropical Africa, surrounding them by a frothy, viscous mass of

[1]Since writing the above I have received a letter from Professor Cope, from which I make the following extract:

"The larvæ are different from those of terrestrial Batrachia in possessing a large hypoblastic yolk, the only approach to such condition having been described in the Genus Alytes. Large yolks are reported in certain tree frogs, and a few others, and it becomes interesting to know the type of frog which has laid these arboreal eggs. Professor J. A. Ryder to whom I submitted the dried eggs, says that the intercellular corpuscles have the truncate form usual in Batrachia."

matter, which is dissolved by the moisture in the rainy season when they become detached and drop into the water where they are hatched. A similar phenomenon has been observed in the case of one of the Hylidæ which has its habitat in Southern Brazil; but in neither case has it been observed that the eggs hatch while attached to the trees. In the case of the Japanese Batrachian it is plain that the hatching takes place upon the trees and the larva possibly undergoes some of its transformations in the nidus suspended among the branches. Whether the glairy mass is due to the swelling, under the action of the semi-tropical rains, of material deposited by the female at the time of oviposition I cannot tell. As against this view is the fact that the dried scum after prolonged soaking in water fails to regain its old vesicular, bubbly form. It may be that the froth is secreted by the bodies of the tadpoles themselves, or that both the tadpoles and the parent batrachian are concerned in its production The large quantity of the mass favors the latter view. The nests were fully a foot in diameter. The presence of dead insects in large numbers in the midst of the masses as well as adhering to its outside suggests that the tadpoles feed upon these.

I looked diligently for the adult batrachian in the vicinity, but failed to discover any frogs in the trees near by or in the pool. Later in the season the trees and bushes are fully alive in places with Hylidæ.

I trust some observer with better opportunities than I had in my brief and hurried visit to Nikko will solve the mysteries of the life history of these arboreal tadpoles.

EXPLANATION OF PLATE XVII.

Fig. 1. Section of nest one-third natural size, representing internal structure and position of tadpoles in the mass.

Fig. 2. Sketch presenting a view of the position of the tadpoles amidst the vesicles. (Enlarged.)

ACROSS THE SANTA BARBARA CHANNEL.

BY J. WALTER FEWKES.

(Concluded from the April Number.)

ON our return to the "Angel Dolly" we found that our cook had prepared a most delicious dinner on shore. We had roast leg of mutton, cooked on a spit, abalones fried and stewed, and coffee. The abalones we collected everywhere on the shore. The animal was cut out of its shell, pounded until tender in an Indian mortar, and then fried in batter. The taste of these animals, after our row in the open air, was fine, but it is doubtful whether we would have eaten the abalones with the same zest under any other circumstances. We ate our dinner under an overhanging roof of rock in a partially formed cave, the floor of which was the shingle of the beach of the cañon. I was reminded of the times when wild men did the same, probably in the same cave, as the abundant shell heaps and inscriptions show that they undoubtedly did. On the roof of the cave there was noticed a curious product of the erosion of the rock, such as I have never seen before. In the mass of conglomerate there is a pocket of grayish rock projecting from the surface and worn into cells, the edges of which stand out in sharp relief. These cells, not unlike honeycomb in form, are rounded, smooth, and several inches in diameter. The edges of the cells are sharp and smooth. The mode of formation of this curious pocket is not clear to me. It is a mass of rock several feet in width, and was formed on the roof of the overhanging conglomerate under which we ate our dinner.

In the afternoon we tried collecting on the black reef, which partially breaks the sea from Star Cañon on the east. I found the sea very high on the reef, but on the lee side a few good things were found. We noticed that the rocks on the seaward side were covered with mussels, among which were a few sea-urchins and beautiful starfishes. The bottoms of the pools in the reef were covered with Zoophytes which, when fully expanded, made them look like flower beds. Among them

were several large Anemones of the genus Bunodes, and many Serpula. Many of the Actinians were over a foot in diameter when fully expanded. The rock which composes the reef is a black asphaltic formation, similar to the embedded rock of the conglomerate on the shore.

We returned to the "Angel Dolly," and found the cook had caught two large fishes known as Garibaldis, which with "crawfish," Panulirus, were served for our supper on board the schooner.

The mainland of Santa Barbara looked dim in the distance as I walked the deck after supper, but the sky above us was clear, and I watched the evening star, Venus, sink below the top of Monte Diablo. It was a very beautiful sight. The air was calm, and there was but a slight swell on the surface of the Channel, which had an almost glassy calm. I was, however, tired out by my experiences, had a good night's rest preparatory to new exploration on the morrow.

On the next morning we concluded to take the "Angel Dolly" up to Prisoner's Harbor, several miles to the eastward of Star Cañon. I thought the best way for me to study the cliffs was to follow in a boat, letting the schooner work up under sail. This seemed more expedient, since the Harbor was exactly to the windward, and there seemed indications that the winds would be light, and perhaps it would be impossible to sail near the coast. The wind, however, freshened considerably after we started, and the "Angel Dolly" worked far ahead, standing out into the Channel. There was a heavy swell throwing high breakers on the cliffs.

Wherever we landed in our trip we were obliged to beach the boat through the breakers, and we were often plunged to our waists in water in landing. Just to the east of Star Cañon, after rounding the black ledge which was my collecting ground the day before, we coasted along past the "Indian Cemetery," from which many Indian remains have already been gathered, and in which many more are still buried. There seemed to be two separate regions of shell heaps, although the whole coast in this vicinity is white with the

shells and debris of the camps of bygone times. In these burial grounds the individual graves were formerly indicated by the ribs or lower jawbones of whales set in the earth above them. None of these now exist, and these shell-heaps have long ago been dug into by eastern collectors. The shell-heaps were not wooded, but here and there are large patches of the prickly pear or "Tunis," and flocks of sheep now graze over the graves of the former lords of the island.

We continued our row past the Indian Cemetery to a natural archway, eroded by the sea, formed by a projecting cliff, on each side of which there is a deep cañon with precipitant cliffs on either side. The cliffs of these cañons are possibly 200 feet high, and so abrupt that they seem almost perpendicular. These natural archways rival in size the famous *Arco Naturale* of Capri, and are among the most instructive instances of erosion on the Californian coast. Of two fiords separated by the cliff of conglomerate, one which we may call Southeast Cañon has a long, narrow entrance, and is stopped up at its entrance by large boulders, which prevent access to the cañon. There is, however, a small, gravelly beach at the mouth of this cañon, upon which we landed. On the right, as we entered, there is a picturesque natural archway, with an old Indian fireplace perched upon it. There are a few pines and wild flowers growing from the crevices in the cliff. A buttress which divides the two fiords from each other is composed of conglomerate. On the right and left are slates in stratified masses, and red colored rocks, the conglomerate above the slates.

From these two cañons we made our way to Prisoner's Harbor, and after some difficulty boarded the "Angel Dolly," which came up soon after.

Without anchoring, for a considerable sea had arisen, we continued to the eastward of Prisoner's Harbor to a point opsite Chinese Harbor, and cast our anchor in smooth water near shore. The rocks at this place differ greatly fom those at Star Cañon. Here we find variegated formations forming white, chalk-like cliff much eroded, and very different from the black, asphaltic rocks of the region to the west of Prisoner's Harbor.

The hills about Chinese Harbor are white and red, and show marked terraces of elevation. At their base there is a continuous beach, made up of small stones and shingle. On the side of the cliff are many bushes, but no trees. The collecting on the beach gave me many mussels, abalones, and a few starfishes. The sea near the beach is turbid with sand, reminding me of the white water of the Florida Reefs.

The hills about Prisoner's Harbor were clothed with verdure. There is a good wharf, and near it the warehouse and a cluster of buildings belonging to the company which owns the island. The hills near the landing place are not as high as those at Star Cañon, and resemble those to the eastward. It is this formation which is mentioned in the meagre accounts which we have of the geology of the island of Santa Cruz.

At Prisoner's Harbor I collected many interesting animals, among which might be mentioned a huge Nudibranch, Chioræa, allied to Aplysia, many starfishes, sea-urchins, and molluscs. Here also I found the interesting Helix,[1] said to be peculiar to the island. One of the most interesting genera of Annelids collected on the rocks near the half-tide mark is the well known Sabellaria. Sabellaria on the Pacific coast builds a thick mass of sandy tubes cemented together, forming on the rocks an incrustation of great thickness. At Punta del Castillo near the end of the beach at Santa Barbara great masses of these colonial worm tubes can be seen, forming a honeycomb structure on the rocks left by every retreating tide. Each worm tube when left out of water is closed by a circular operculum which effectually blocks up the entrance, forming a kind of door to prevent possibly the egress of water. By this simple arrangement the animal can live for a long time out of the water. A most interesting method of casting off the excrementa is also illustrated in this worm. The operculum is situated at the cephalic extremity of the animal, and as the masses of tubes are crowded together, the posterior extremity of the animal is

[1] This species is rapidly being exterminated by the sheep, and in no short time will probably be extinct except in inaccessible cañons. Mr. Gulick records a like fate for certain Achatinellas peculiar to the Sandwich Islands.

brought to the blind ends of the tubes. There is, however, appended to this extremity a long tube, which, bending backward, opens near the open end of the case of sand. The vent of the animal is situated at the extremity of this tube and is thus brought to the surrounding water.

Encrusting the rocks in several places we also found a moist deposit of sand of one or two inches in thickness, also closely connected with an interesting habit of another and different group of marine animals. Bunodes, a common Actinian of the southern Californian coast covers itself with a coating of sand, and when the tide falls the animal contracts its tentacles, and nothing is to be seen but this sandy deposit, concealing the body of the Actinian. In this way the genus lives between successive rise and fall of the sea, shielded under its coating of sand for hours, enduring great changes of temperature and the lack of the pure sea water. Colonies of these Bunodes were found many feet above the low-water mark. They also are common on the rocks of the well known headland, Punta del Castillo, and can without difficulty be observed by anyone who will visit this locality at low or half tide.

The island of Santa Cruz, as pointed out by Mr. Greene, has a peculiar flora which has many species not found on the neighboring continent, and genera which are only found in lands widely distant from it. It has also a peculiar species of Helix. In a word, although a continental island in its fauna and flora it reminds one of an oceanic island. Shall we interpret these facts by regarding it as a remnant of a continent or large body of land contiguous to California now submerged, or are other explanations to be sought? There is certainly not much to indicate an oceanic character to the Santa Barbara islands. Their peculiarity of flora can readily be explained by considering a change which has taken place in the climate of the mainland without affecting that of the islands. A change in the amount of moisture may have driven out the less hardy genera from the mainland, but left them still to survive on the islands. Moreover, a glacial period in California may have driven more hardy plants southward into a struggle with the less strong, in which

the latter have succumbed. In a desiccation of the country the progress of the change would be less rapid on the island.

It seems to me that there is evidence that the island of Santa Cruz has lately been elevated out of the sea. This is the story of Ragged Mountain with its cleft summit, and of the elevated terraces to the west of Chinese Harbor. The deep cañons, however, show a much larger rainfall in the past when they were made than at present, and the enclosed asphaltic boulders standing out in the conglomerate are good indications of great erosion. The huge rocks blocking up the entrance to the cañons do not seem to have been brought there from the hilltops, but eroded by a mountain torrent on either side have simply dropped into the position which they now occupy. In most of these cañons the torrents which caused them have dwindled in size, although still large in the rainy season, while in many their beds are now dry during part of the year. If there ever was a glacial period on this island the tracks of it at present have been obliterated, or were not discovered in my superficial examination. There has been great erosion, but the boulders clinging to the worn side of the rock by one angle would seem to indicate that that erosion was by water rather than ice.

As we left Santa Cruz on our return trip we sailed through multitudes of a beautiful Velella, common in the channel at certain seasons of the year. These little blue sail-boats are often thrown up on the beach at Santa Barbara, and are common as far north as Monterey and San Francisco. Its northern limit is many miles north even of the limits of the state.

A curious little physophore, *Athorybia californica*[1] was also seen in the channel near Santa Cruz. This beautiful animal has never before been recorded from the Pacific waters of our west coast, although a similar genus has been described by the author from Key West and the Florida Keys.

The largest and most attractive of the Medusæ seen in my trip back was a mammoth Pelagia with mouth tentacles four feet long, and of a beautiful pink color. A lovely Hydromedusa,

1 An account of the anatomy of this physophore is given in the *Annals and Magazine of Natural History.*

polyorchis, is one of the most common jellyfishes in these waters.

Perhaps the most interesting of all the Medusan denizens of the fiords of Santa Cruz is a small Hydromedusa, not larger than a small pea, which has this remarkable character. In place of clusters of tentacles about the margin of the bell it has but a single tentacle placed at the point of junction of the radial tube and the circular vessel. This single tentacle is a short, stiff appendage, exactly similar to one of the four tentacles of Dipurena, a genus found at Newport, Rhode Island. It is, in fact, as if we had a Dipurena with three of the tentacles missing and a single one remaining. In this Californian genus, however, there is but one of these curious, club-shaped, stiff appendages. A similar genus has never been recorded; to this species I have given the name *Microcampana conica*. The most peculiar structural character is found in the number of radial vessels in this jellyfish. All similar Hydromedusæ have but four, eight, or more radial tubes. There are some which have six, which however are not related to Microcampana. This genus has six radial tubes. Moreover, there exists on the apex of the bell, as in our Stomatoca, a prominent prolongation or projection never seen in Dipurena, its nearest ally.

There are many other Hydromedusæ in these waters, a notice of which would prolong this account beyond its limits. A huge Sphaeronectes, with a bell a quarter of an inch in diameter, a genus never seen before on this or on the Atlantic coast of the United States, a beautiful Physophore, Diphyes, and a host of others[1] were found.

On the return trip to Santa Barbara we sailed through a most extraordinary region of the channel in which there is a submarine petroleum well. The surface for a considerable distance is covered with oil, which oozes up from sources below the water, and its odor is very marked. The oil probably comes from the upturned asphaltic strata deep below the sea.

Near the oil well we sent down our dredge and brought up a most interesting Polyzoan, an account of which I have al-

[1] A full description of these animals with figures will soon be published by me.

ready published in the January number of the *Annals and Magazine of Natural History*. This animal has a jointed stem and an oval zoœcium. When it first came on board I thought I had discovered a living Cystoid or Blastoid, as its shape was almost the same as that of some genera belonging to these types so familiar to the geologist, but now long extinct. In this, however, I was disappointed, although abundantly rewarded in finding a new genus of Polyozoa, Astrorhiza.

The dredge also brought up great masses of a Retepora, which is called coral by the sailors in this locality, and are sometimes larger than a man's head. Innumerable other lower animals people these depths.

A fair but light wind brought us back to the wharf of Santa Barbara early in the evening of the day we left Prisoner's Harbor. We heard the sound of the evening bells of the Mission Church come down the side of the mesa, and as we threw our anchor the bright electric light of the city welcomed us home. The next morning a haze covered the base of the island of the Holy Cross, out of which rose the peak of Ragged Mountain like a monster from the sea. As the day wore on the fog lifted, and the soft African haze which gives the great charm to Santa Barbara ocean scenery took its place and the form of the beautiful island came out in all its extent, its outlines softened by the distance, and its dark cañons alternating with projecting headlands indistinguishable over the stretch of water which separates it from the mainland. The same island stands out clear in the beautiful light, unchanged since Cabrillo sailed up the channel for the first time fifty years after Columbus discovered the New World.

THE VEGETATION OF HOT SPRINGS.

BY WALTER HARVEY WEED.

THE vegetation of hot waters, though lowly organized and composed of obscure forms, is of considerable interest to all students of Nature, since the plants occur in very highly heated and mineralized waters under conditions that are fatal

to all other forms of life. The ability possessed by the vegetation found in such waters to withstand such extreme and adverse conditions of environment shows the possible existence of this form of life during the early history of our globe, when the crust of the earth is supposed to have been covered with hot and highly mineralized waters. Such plants may thus represent the earliest links in the chain of evolution.

While the mosses Hypnum and Sphagnum have been found in warm waters (90°–100° Fahr.), the vegetable life of hot water consists wholly of fresh water algæ. Such plants are usually less striking in appearance than the sea-weeds, but assume most curious and interesting forms when subjected to the peculiar conditions that prevail in hot springs.

It has long been known that algæ occur in hot waters, and the descriptions of hot springs given by travelers often contain allusions to the presence of bright green "confervæ" living in the hot pools and streams. Algæ are common also in the hot waste waters flowing from many mills, the brilliant green growths lining the conduits. Where the plants present in thermal waters are of this color, their vegetable nature seems to have been readily recognized; but there is good reason to believe that the existence of algæ of other colors, particularly the pink, yellow and red, forms so common in the Yellowstone waters, have been overlooked or mistaken for deposits of purely mineral matter. That such is the case is not at all surprising, for the plants often surround themselves with a hyaline gelatinous envelope, or are encrusted and hidden by mineral matter extracted from, or deposited by, the hot waters, and sometimes obscuring the plant growth so completely that the organic nature of the substance is scarcely recognizable even by an algologist. Thus the Beggiatoæ, the characteristic vegetation of sulphur springs, were long considered a lifeless organic slime. Their silky threads are often completely hidden by grains of sulphur, or entombed beneath a deposit of gypsum.

The vegetable life of hot calcareous waters is very often

shrouded in carbonate of lime, the growing tips alone projecting out of the stony mass. In ferruginous and in siliceous waters the mineral matter of the waters obscures and hides the vegetable filaments. Unfortunately, those who have studied the flora of hot springs have rarely published sufficient detail concerning the habitat of the species described to enable one to follow up this interesting feature of the subject, while the algæ have been studied rather from a systematic than a broad biological standpoint.

In reviewing the literature bearing upon the subject, I have found that vegetable life is a common accompaniment of thermal springs, and as widely distributed as the springs themselves. At the noted warm springs of Carlsbad, where the algous life has been studied by several botanists, there is a great variety of species, but the limiting temperature appears to be 130° Fahr.[1]

Sir William Hooker[2] and Baring Gould[3] both mention the occurrence of crimson algæ in the hot geyser waters of Iceland, and Hochstetter[4] and other writers[5] describe slimy confervoid plants lining the bottoms of hot pools and streams in New Zealand, the highest temperature at which such growths have been observed being 153° Fahr.

In the hot springs of the Azores, Mosely found algæ growing in water whose temperature was between 149° Fahr. and 156° Fahr., and on areas splashed by almost boiling water. At the volcano of Camiguin no vegetation was found until the water had cooled down to 113.5° Fahr.[6] In the Himalayan hot springs Dr. Hooker found a luxuriant growth of Leptothrix at 168°Fahr. and below.[7] Several other references were

[1] Abhandl. Schles. Gesell. 1862. Heft II.

[2] Journal of a Tour in Iceland. Vol. I., p. 160.

[3] Iceland: Its Scenes and Sagas.

[4] Reise der Oe Frigate Novara.

[5] Skey. Trans. N. Z. Inst. Vol. X., p. 433. Spencer. Trans. N. Z. Inst. Vol. XV., p. 302.

[6] Journ. Linn. Soc. (Botany.) Vol. XIV., p. 328.

[7] Himalayan Travels. Jos. Dalton Hooker. Vol. I., pp. 27, 379.

found proving the abundance of algæ in waters of 150° Fahr. or below. The highest temperature at which these growths have been found is that observed by Professor Brewer at Pluton Creek, California, where algæ were found at 200° Fahr.[1]

In the hot springs of Ischia no life was observed above 185° Fahr.,[2] and this appears to be the limiting temperature in the hot waters of the Yellowstone National Park.

A comparison of the species found in hot springs shows that they are limited to a few groups. Although the true Confervoideæ and the Protococcoideæ are represented in gatherings from hot waters, the Oscillatorieæ form the most characteristic vegetation of hot springs, species of Oscillaria and Hypheothrix being very common. *Hypheothrix laminosa* (a species variously known under a number of synonyms) has been found in New Zealand, Java, St. Paul, Camiguin, Iceland (?) and the Yellowstone Park, being very common at the last locality.

Desmids have been found in the hot waters of the Azores, three species of Pediastrum being described, and Corda figures and describes Desmids from the Carlsbad hot springs. The Diatomaceæ do not appear to be very abundant in hot waters. Dr. Jas. Blake found a number of species at 140° Fahr. in the hot springs of Nevada, and nine species were found by Berkeley in the gatherings from Thibet. They are comparatively rare in the Yellowstone gatherings from hot water, but very abundant in the cooled waters from the springs.

The examinations made by Mr. W. Archer of the gatherings of algæ from the hot springs of the Azores show that certain species were identical with forms common in cold surface waters in Great Britain. Prof. W. G. Farlow, of Harvard, who is studying a series of specimens collected by the writer from the hot waters of the Yellowstone Park, informs me that here also cold water forms are found, but modified by their conditions of environment. It is hoped the material in Professor

[1] Amer. Journ. Sci. (2.) XLVI., p. 31.

[2] Sachs, in *Flora*. 1864.

Farlow's hands will yield important information concerning the morphology of the species.

In a study of the hot springs and the geyser phenomena of the Yellowstone National Park, carried on in connection with my geological work in that region, I was surprised to find an abundant algous vegetation in the hot springs even at very high temperatures. It has been found by an examination of the hot springs of the region, of which nearly 3,500 have been individually and carefully noted, that algæ are almost universally present either in the springs themselves or in the streams flowing from them. The only exceptions to this are the mud bowls, and even here algæ are often found on the borders where kept moist by steam. This widespread occurrence implies that algæ can exist under a very great diversity of conditions. The springs examined differ greatly in the chemical composition of their waters, and include carbonated, calcareous and siliceous alkaline waters, and also those acid with hydrochloric or with sulphuric acids. The algæ also occur under equally diverse thermometric and hygrometric conditions; they have been found at all temperatures up to 185° Fahr., though from 160° to 185° they have thus far been observed only in running streams.

It is difficult to give a general description of the vegetable life of hot springs which shall be brief, and yet convey any idea of the beauty and the varied forms of these growths. The vegetation of the acid waters (with free HCl or H_2SO_4) is seldom a conspicuous feature of the springs. But in the alkaline waters that characterize the geyser basins, and in the carbonated, calcareous waters of the mammoth hot springs, the case is otherwise, and the red and yellow tints of the algæ combine with the weird whiteness of the sinter and the varied blue and green of the hot water to form a scene that is, without doubt, one of the most beautiful as well as one of the strangest sights in the world. Those who have been so fortunate as to have seen the hot water fountains of the Yellowstone will be sure to remember the delicate and charming tints that characterize the basins about Old Faithful and many other geysers

of the upper basin, as well as the bright reds and yellows of Specimen Lake and the Orange Pool.

Early in the study which was made of these springs, it was noticed that the color of the vegetation was, in a degree, dependent upon, or related to, the temperature of the water. This is well illustrated by the occurrence of *Hypheothrix laminosa*, whose delicate filaments wave in the stream draining the Black Sand, where the following relation of color to temperature was observed:

White—185°.

Flesh pink—181°, becoming browner as the temperature falls.

Pale yellow—164°.

Yellow green—155°.

Emerald green—135°–140°.

Dark green—130°. These colors merging, of course, into one another, but being very prominent at the temperature given. Other growths are:

Orange—125°.

Red—110°.

Cedar brown—90°.

An examination of the growths forming the first series by Professor Farlow proves that the flesh-colored and white growth, occurring at 180°–185°, shows but traces of algæ filaments in amorphous matter. At 164° the structure was more decidedly filamentary and the color light yellow. The bright green forms at 155° were in a better condition for study, and the dark green filaments at 130° were in good condition. *Hypheothrix laminosa* probably attains its fullest and most perfect development in these waters between 130° and 155° Fahr.

In those clear bowls of hot but never boiling water called *laugs*, the algæ often form a leathery sheet lining the sides and bottom of the pools. Each sheet consists of a great number of thin, membranous layers aggregating one-fourth to one-half inch in thickness; the under layers are a rich tomato red, and the surface covered with a thin, incoherent

fuzz of green, through which the red tint beneath shows and produces an olive tone.

The algæ tinting the hotter *laugs*, with temperatures of 140° to 160° Fahr., are bright yellow, and form a loose, velvety nap on the soft, siliceous sediment.

Where the overflow from a spring is constant in volume the channels are rapidly filled, choked and dammed back by masses of red and green algous jelly from one-half to five inches thick. This form of growth and the process of sinter formation has been already described elsewhere.[1] The channels carrying off the periodic discharge of the geysers are also brilliantly tinted by algæ, but modified by the deposit of silica. The channels of Old Faithful are a brilliant gamboge yellow near the geyser, merging into orange, which changes abruptly into brown, while farther away the growth is cedar red.

In these cases the plants form a thin, slippery coating upon the siliceous sinter, and is much encrusted by silica. Where from any cause the algæ growing in these channels are deprived of their supply of water, the siliceous jelly enveloping the growth is rapidly dried, and becomes hard, white and opaque, effectually concealing the algæ. Where channels are lined with a membranous growth, this shrivels up into curious convoluted forms, or into papyrus-like rolls. In fact, whatever the nature of the algæ present in the siliceous waters, all appearance of vegetable life is soon lost on drying, owing to the hardening of the silica. In calcareous waters the change is none the less complete, and the green or red growth rapidly bleaches out and becomes all but invisible to the casual observer in the deposit. The filaments may, however, be freed from the lime by the aid of acid.

[1] Amer. Journ. Sci, May, 1889.

PLATE XVIII.

Fig. 1. Shell Bead.

Fig. 2. Bone Harpoon.

Fig. 3. Bear's Tooth.

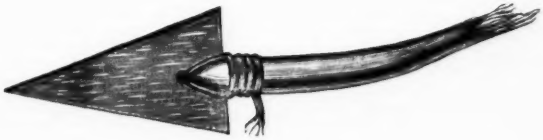

Fig. 4. Arrow-head.

CAYUGA INDIAN RELICS.

BY W. M. BEAUCHAMP.[1]

I HAVE been much indebted to Mr. W. W. Adams, of Mapleton, Cayuga County, for valuable information regarding New York Iroquois sites, and for the opportunity of examining and figuring many fine and remarkable relics. Like some other parts of the Iroquois territory, the occupation of the country about Cayuga Lake, by settled inhabitants, seems very recent. There are a few old sites, but by far the larger part are of historic times. There are half a dozen early earthworks in the county, but most of them are distant from the lake. As in the country of the early Senecas, there is little earthenware, and that of a coarse kind, contrasting strongly with the abundant supply of the territory of the Onondagas and Mohawks. From history, traditions and remains, as well as language, it seems probable that the Cayugas and Senecas branched off from the parent stock at Lake Erie, perhaps on both sides; while the three eastern nations led the van on the north of Lake Ontario to the St. Lawrence, and thence passed southward to their later homes. Archæologists certainly have good reasons for such a belief.

There were travelers and early hunters and fishermen along Cayuga Lake, some of whom had small villages there for a time. A few left mica in graves, and lost some fine articles in the camps or by the wayside. Long shell beads were used by some, and as these have been found in recent graves as well, they form a link with the past. The wearers were probably the first true Cayugas. These long beads were formed from the columellæ of sea shells, and one is six and three-quarter inches long, while a number are but little less. Out of one

[1] Rev. W. M. Beauchamp has long been noted for his investigation of Indian archæology in Western New York. He is an indefatigable laborer, and his investigations have been of great benefit to the science. He is more disposed to observe and record facts than to develop theories. His last remark in the above paper is worthy of consideration. It has come to be a maxim in some parts of the world that prehistoric objects are to be found, not in number as they exist, but according to the number and diligence of their seekers.—T. W.

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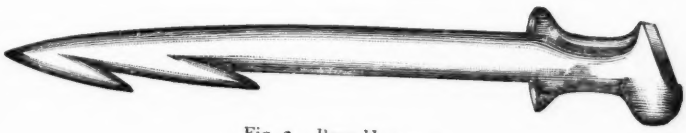

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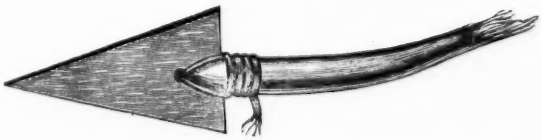

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grave Mr. Adams took four which aggregated twenty-two inches, and six more formed a line of the same length. Fig. 1 is of the exact size of one of six taken from a grave last year. This grave contained a most curious assortment of articles, of which I will speak particularly before concluding. While smaller beads of this kind occur on historic sites, and very rarely on prehistoric villages, I know of none so large elsewhere in New York. The chiefs who wore them in their first splendor must have been proud of their ornaments.

While prehistoric shell beads of any kind are so rare through the old Iroquois territory of New York, the small council wampum, of course, is found only on later sites. The Five Nations had none of this before the coming of the Dutch. This is a fact now clearly established. There are other late beads of bone, stone, porcelain, glass, and discoid and oval shell beads. Sometimes mere shells of Melampus and Marginella have been strung, but never any fresh water univalves, as far as I know. The Venetian glass beads are often of many colors and intricate patterns, and sometimes of singular beauty. Some plainer glass beads are quite attractive also.

Ornaments of perforated red slate and pipestone belong also to the later sites, but most of those gathered by Mr. Adams now grace the cabinet of Mr. A. G. Richmond, of Canajoharie. A pretty little mask of Catlinite, smaller than a finger nail, came from a recent Cayuga grave. I have seen but one other as small, and that from an Onondaga site of A. D. 1700. Shell and bone ornaments include the familiar Iroquois forms of disks, crescents, fishes, and those to which we can hardly give a name. Combs came with the white man, but the Indian soon made for himself those of bone or horn, the top generally symmetrically arranged, as two men, two serpents, two birds. Fine examples of these have come from Cayuga sites—indeed, the best I have seen.

The bone harpoon, Fig. 2, is from a recent Cayuga grave, and most large harpoons that I have known are not old, say two hundred and fifty years or less. I have figured them from historic sites of the Onondagas and Mohawks besides.

This one is stained red, a rare feature, and it presents other peculiarities. A smaller slender and delicate harpoon was found near the lake shore, and I have seen none prettier. It has six barbs on either side, and seems much older than the one represented. The same form, but less delicate, occurs on the Seneca River.

Both copper and iron fish-hooks are met with, and sometimes the corroded metal has preserved the cord. None of bone or horn have appeared near Cayuga Lake, though several have been found in Onondaga and Jefferson Counties. Three or four prehistoric specimens, with barbs, have come to my notice. Among other Cayuga fishing implements are innumerable flat sinkers and perhaps the ovoid grooved stones. The former are of more general distribution than the latter.

Bears' teeth occur, as in other places. Fig. 3 is one of sixteen from the same grave. They were used much earlier, and often perforated for suspension. Human teeth I have found thus perforated. While examining an old Cayuga burial place, Mr. S. L. Frey, of Palatine Bridge, found an arrow made of a fossil shark's tooth, only altered by cutting slits to bind it to the shaft. A single glass bead, found at the same time, makes its age doubtful.

Stone arrow and spear-heads are in moderate numbers; scrapers and drills very rare, owing to the small number of early Cayuga sites, these being early implements. Some of the triangular arrows, made of sheet copper or brass, occur, generally with one or two perforations for binding the arrow, but sometimes with none. Fig. 4 shows one with part of the shaft remaining attached. They are of the same pattern as those found with the Fall River skeleton. Mr. Adams has also belts with copper tubes, suggesting those encircling the skeleton mentioned. Such arrows in Onondaga belong to the latter half of the seventeenth century. The copper age of the Five Nations lasted nearly a century, when they adopted silver for ornaments. During the earlier period of European contact they used copper wire bracelets, brooches and ear-rings, bronze rings, copper beads, and other articles. Of these Cayuga

affords good examples, as well as the other cantons. Iron is found on all recent sites.

Good clay pipes have proved abundant near Cayuga Lake, and the ridge along the sides of the stems of many is an unusual feature. They present the common variety in form and ornament. Fig. 5 is called a wolf-totem pipe by Mr. Adams, who took it from a grave last spring. It is of the type common two hundred years ago. A little later the Indians reversed the arrangement of the head or ornament. A curious detached terra cotta Cayuga ornament represents a man's head with a pointed helmet. These detached ornaments are found in other parts of the Iroquois territory. Slender pewter and iron pipes are rarer, but the former have quite a range. Stone pipes were little used by the Cayugas or their predecessors.

Figs. 6 and 7 Mr. Adams calls gambling flints. The larger one may be a frequent form of knife, or he may be correct in his name. The smaller one is quite likely to have had such a use. Had they shown signs of wear, I might have thought them Indian gun-flints; but there is no good reason for this, and their place in a chief's grave gives them some importance. They are not of the scraper form, and are too small for ordinary knives. Twenty-one occurred in one Cayuga grave, but I have found them singly in Onondaga County. They are neatly chipped, and suggest the bone, stone and clay counters once used, now represented by peach stones and deer buttons.

One curious article Mr. Adams has loaned me, which is probably old. The point of a flint arrow had been broken off, and below the fracture a deep indentation was neatly chipped, making the whole not unlike a rude fork. Like the concave or curved scrapers of Onondaga County, it may have been employed in forming arrow shafts, though not a true scraper like them.

Fig. 8 is of a horn implement, perhaps a punch for ornamenting pottery, though of rather a late date for that. This is a Cayuga form, but they are found on other sites of the

middle of the seventeenth century. In a very old grave Mr. Adams found a slender marrow-bone, the central part shaved down into a long elliptical opening. The cavity was filled with paint, and a slender pestle for mixing paint almost closed the orifice. In this grave was a large piece of mica.

Some old burial places present curious features. In one spot an upper stratum of bones had been disturbed, but on removing a layer of soil two inches thick another would be found, and thus until the fourth bottom course was reached. Sometimes a single skeleton occupied one course, and then there might be three or four side by side. Ten or twelve would be the average in the successive burials, but in one case there were over twenty. One or more skeletons would have accompanying articles, and these were early burials.

Here is a curious and suggestive list of articles found in a Cayuga chief's grave last year by Mr. Adams: "Seventeen flints, 2 gun-flints, 6 bullets, 6 baldric beads, 1 bone harpoon, 3 buckhorn handles, 1 knife with buckhorn handle, 21 gambling flints, 3 bars of lead, 5 rubbing stones, 16 bears' tusks, 2 axes, 1 brass kettle, 2 pair shears, 4 pair bullet moulds, 2 gun-locks with flints, 47 pieces gun-locks, 2 iron shears, 32 knives and cutting implements, 1 gun, 1 pipe, 1 piece death paint (plumbago), 1 piece mica, 2 trigger guards, 1 wormer, 1 gun-cleaner, steel and 2 flints, a quantity of powder in a cloth bag, 2 melting ladles, 2,500 wampum beads." Each bar of lead weighed three pounds. The mica shows a modern as well as ancient use, and some other articles would elsewhere be thought old.

Of recent articles Mr. Adams has obtained a large number, and some of those of the Jesuit period are of much interest. Copper kettles prove much more frequent than vessels of clay, and many articles still used by the New York Indians occur. The valley of the Salmon Creek was once rich in remains, and accounts were published long ago of the large quantities of iron and brass taken thence to Auburn for sale. They were plowed up for a space of several miles in length along the bottom lands.

As in other cases, the Cayuga relics cannot all be classified, and some are found which are sufficiently puzzling. Among these are some of the ruder implements. These may be passed over now, but the foregoing account will show what may sometimes be done in a short time in a field supposed to have been exhausted.

DAYS AND NIGHTS BY THE SEA.[1]

BY FRANCIS H. HERRICK.

FOR one who has spent his life inland, a visit to the sea and especially to the tropical sea is an event to date from. The revelation of a new world awaits him. Strange forms innumerable meet him at every turn, and he soon comes to realize that the sea is the great home of life.

The simple outfit of thirty years ago is utterly inadequate for the student of nature of to-day who hopes to add anything of importance to our knowledge of the organic world. He needs not only good microscopes, drawing materials, ample aquaria and dredging apparatus, but a large assortment of chemical reagents, the uses of which in the preservation and study of living matter has almost revolutionized the science of biology.

Nearly all marine animals discharge their eggs into the water in vast numbers, and the young which are hatched from them, in most cases, lead an independent swimming life at the surface of the ocean. This locomotor larval period as it is called, may extend over weeks or months, and is shared by animals which in the adult state have the most diverse habits, such as the coral, the barnacle, and the mussel, which are firmly anchored to some solid support, the starfish and sea-urchin, the jellyfish and annelid, the crabs and prawns, the salpas and amphioxus; and also the fishes, the highest type of marine life which pass their early stages at the surface of the

[1] Part of a lecture delivered in the "University Lecture Concert Course," Jan. 31, 1889. Western Reserve University, Cleveland, Ohio.

PLATE XIX.

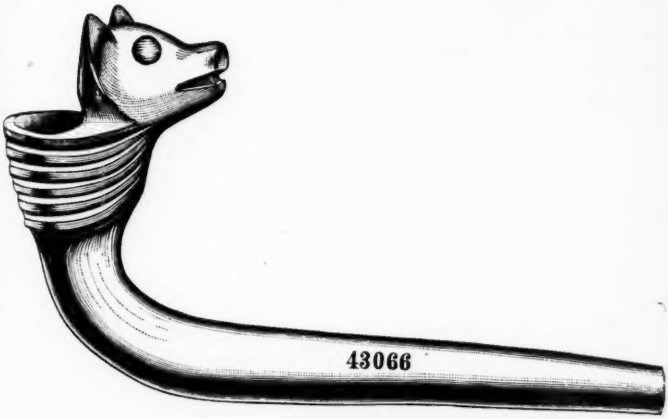

Fig. 5. Clay Pipe.

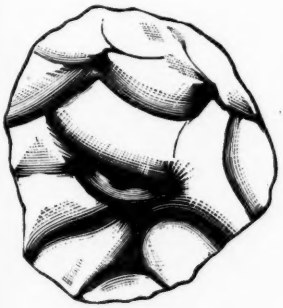

Fig. 6. Gambling Flint.

Fig. 7. Gambling Flint.

Fig. 8. Horn Implement.

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sea. The young of these and of a hundred other forms swarm in the surface water on still evenings, in countless myriads, the most delicate creatures, many of them as transparent as glass, and so small that it requires a microscope to see them. After passing through metamorphoses more wonderful than any described in the tales of Ovid, the remnant of this host which nature allows to live, takes on adult characters. The young crab or prawn after having gone by several aliases, and played as many distinct roles, sheds it skin once more, sinks to the bottom and except in point of size is indistinguishable from an adult. One would hardly have guessed that a larva like that of the mollusc with its enormous locomotory sails, and its delicate fringes of cilia, would ever develop into a sedentary slow-moving gastropod, or that the grotesque microscopic larva, shaped like a painter's easel, would ever turn into into a symmetrical starfish with its five horizontal rays.

If one spends a few hours in the gulf stream on a calm day or night, he cannot fail to be impressed by that vast stratum of living beings, which this great ocean current bears hourly upon its bosom. Once when off our southern coast, we sailed through a school of medusæ which must have covered many square miles of ocean. They were little brown bells, the size of thimbles, and the indigo water was peppered with them. We encountered them at about four o'clock in the afternoon and for more than an hour their numbers did not sensibly diminish. But at night the dark waters glow with the phosphorescence of those minute and obscure beings whose presence one would not suspect by day unless he had microscopic eyes. Through every mile that the ship ploughs her way, her bow encounters a steady stream of shooting stars. Every movement in this living water precipitates a shower of sparks, and every spark is due to an organism. There are stars of the first magnitude, like the large medusæ glowing like red-hot cannon balls, besides a whole galaxy of lesser lights.

Much of the time of a naturalist at the seaside is spent in the collection and study of these pelagic larvæ and the adult forms which they represent. A calm summer's evening when

not a ripple breaks the mirror of the surface, is best for this purpose. With a companion to take turns at rowing, or to hold the net, we glide off in the darkness to some point where a distinct current sets, or better still where two currents meet, for in such places pelagic larvæ are most abundant. The apparatus for "surface collecting" as it is called, is simple enough. It consists of a tow net made of bolting cloth or coarsely woven silk, through the meshes of which the microscopic animals cannot pass, and a bucket of sea water. The net is put out and allowed to skim the surface as the boat moves slowly through the water. If the place and time are very favorable the net soon begins to glow, as if made of platinum gauze, heated white hot, and at short intervals it is cautiously raised to the boat, and the sparks are washed off into a bucket of sea water, and the process repeated. After returning to the laboratory, the water containing the evening's catch is carefully examined by each student, who selects and preserves those particular organisms which he happens to be at work upon at the time.

If a tall beaker of this water is dipped from the bucket and held up to the light we may behold a most remarkable and fascinating sight. Every drop is teeming with life. The myrmidons of the deep are here. The young of almost every type of marine life has a representative in our glass, but so disguised are many in their undeveloped state that only the specialist may recognize them. They vary in size from half an inch long down to microscopic proportions. Some are adults. There are innumerable larvæ of crustacea, of grotesque shapes, moving with quick jerks; some with the body stuck full of spines, or with a huge straight spear growing out of the forehead; glass-like Ctenophoræ reeling through the water, propelled by encircling bands of irridescent cilia; veliger mollusks floating with sails wide spread; bead-like larvæ of annelids, which swim with rapid rotatory movement: the colorless eggs and quaint fish embryos, whose large black eyes and enormous golden yellow yolk sacs, attract the eye while their transparent body is hardly visible; the pulsa-

ting bells of ghost-like jelly-fish, rising and falling as they deliberately contract and expand their discs; the floating Siphonophoræ transparent as the air and delicate as spun glass. In the turmoil of the moment a thousand strangely beautiful forms pass rapidly before the eye.

The larvæ selected for study are carefully set aside in beakers of sea water, or in watch glasses, and it is sometimes possible to keep them alive for a number of days, and observe their transformations, but usually unless there is means of providing them with freshly aërated sea-water, this is not possible. Some forms are so delicate that one is hardly able to bring them in alive. They die as soon as caught.

Where it can be done, by far the most satisfactory method of studying the development or life history of an animal is to procure the adults and keep them under observation until they deposit their eggs. The development of the ova can then be studied with the closest detail, not only by the superficial view of the growing embryo, but by means of the sectional method which has yielded such valuable results to natural science in the past ten years.

In the case of many animals, such as fishes, "king crabs," oysters, starfish, and sea urchins, where the sexes are separate, the ripe eggs can be obtained and fertilized artificially, and the complex processes by which the highly organized fish or mollusc is slowly built up by changes which start in the germ cells, can be witnessed in all their details. Animals differ very widely in this respect however, and the vitality of the ova is connected in some cases certainly with that of the animals themselves. Starfish or Ophiurans may be sadly mutilated without killing them, and some of the molluscs are notoriously hardy. A year and a half ago I brought from the West Indies a collection of marine shells, gathered in the water or on the coral rocks on shore. They were done up in a package and sent with other collections to my home in New Hampshire. The next fall when the bundle was opened, much to my surprise a number of the univalves (*Tectarius muricatus*), were alive and crawling about. In one of our eastern colleges,

some molluscs brought from the Holy Land were placed in the college collection and duly labelled, when some of them exhibited their vitality by walking off the museum cards.

The "Horseshoe," or King Crab which anyone who goes to the Atlantic seaboard can usually find on any sand-flat, is an animal remarkable not only for its great antiquity, but for its extreme hardiness which is perhaps one cause of its great age. They are found fossil in the primary rocks, in the Cambrian and Silurian formations, and therefore excepting the Foraminifera, they are among the oldest animals known. The related trilobite has perished utterly, and a whole army of other forms, but the King Crab has existed during all these ages and has altered but little; hence we must infer that their conditions of life have been nearly uniform during this immense period. When the embryology of this animal was being studied at the Marine Laboratory of the John Hopkin's University at Beaufort, N. C., a few years ago, an attempt was made to fertilize the eggs artificially. As the ova did not at first show any of the usual signs of development, but began to swell as if undergoing decomposition, they were set aside and forgotten. In about 3 weeks from this time the dish was examined by chance, when it was seen that the young king-crabs were just leaving the shell, notwithstanding the fact that the water in which they had lived was impure, and had nearly evaporated. The following anecdote which illustrates what the adult King Crab can stand, I heard from Professor Brooks of the Johns Hopkins University. While he was studying with Louis Agassiz at Cambridge, Milne-Edwards, the renowned French naturalist sent to this country for some specimens of the American King Crab, on which he was then preparing his well known monograph. The animals as soon as captured were taken to the Cambridge laboratory and thrown under a building, where they remained some weeks, exposed to a low temperature. They were then packed up and sent abroad, and when they reached Paris, some of them were still alive. It is interesting to notice that this animal is not a Crab at all, nor indeed a Crustacean, as the recent study of its development has

most certainly shown. It is more nearly related to the Spiders.

The case is very different with the ova of many other animals, for instance the eggs of prawns such as the Lobster and the Shrimp. They are not discharged into the sea, and left to take their chances with enemies, but are attached to the body of the animal which carries them about until they hatch. In most cases they are fastened by fine threads of glue to the swimming legs, and as the constant motion of these appendages is shared by the eggs, the latter are always well aërated. If the ova are removed from the animal, they invariably die.

Some Crustacea (like the Stomatopods) lay their eggs in masses in burrows in the sand or in coral rocks, and if they are removed and placed in an aquarium, they also die. But if the habits of these animals are studied, it is found that either the male or female is always brooding over the eggs and fanning them with its legs, thus supplying the needed aëration by the currents of water set up. This process of supplying the necessary oxygen is seen in fish-hatching houses, where the eggs are laid upon shallow trays, over which a stream of water is constantly passing.

The eggs of animals like the Corals and Sea-fans can be easily obtained in the breeding season, by placing a colony of the polyps, like a piece of living coral, in a glass dish or aquarium. The minute spherical eggs or young will be discharged through the mouths of the polyps and float to the surface, when they can be skimmed off, transferred to other dishes and their development watched. With the modern appliances and methods of research, the naturalist of to-day can investigate the problems of animal life with far better success than was possible a generation ago. How is the life history of an animal written? How do we trace the numerous links in the chain of events between the one-called, apparently homogeneous egg, to the highly complex animal which produces the egg? To answer this question very briefly we may conveniently select the shrimp, although we might choose equally well a fish, a sea-urchin or a coral.

It is well known that the eggs of the higher animals, the mammals, are few in number, and that when fertilized, they are not discharged, but remain and develop in the body of the parent. Partly for this reason the embryology of the higher forms is much more difficult, but the eggs of the lower animals, like Crustacea, Corals and Starfishes, are deposited in very great numbers. The number of eggs laid by the edible Crab (*Neptunus hastatus*) of the Southern States, for instance, is estimated at 4½ millions. The eggs are not only passed out of the body, but in many cases develop quite independently of the parent. Consequently a store of food called *yolk*, is laid up in the egg, as we see in the hen's egg, for the use of the growing embryo.

We start with the fertilized germ cell the egg, although it should be remembered that there is a long series of events before this is reached. The germinal cell itself is derived from other cells in the tissues of the mother and the tissues which compose the body, are themselves derived from the egg, and this cycle is repeated generation after generation. The male germinal cell, which in fertilization unites with the ovum, has a similar origin, so that the egg, from which the animal springs is not as simple a structure as one might suppose, but a microcosm in itself, containing as it must the hereditary germs of a long and complex line of ancestors.

As a rule an egg does not develop unless it unites with another kind of cell, called the male germinal cell. This rule is however violated, in the case of the parthenogenetic insects, the Gall-wasps, Bees and Moths, and in some Crustacea, where the eggs develop without fertilization, and where the males are sometimes wanting.

The egg of the shrimp, like that of the hen or tortoise consists of a large mass of food-yolk, surrounding the more essential part of the cell,—the nucleus, as it is called, the whole being enveloped by a protective membrane, the shell. Beginning then with the single egg-cell (which, if fertilized, is of course duplex in nature,) the animal is slowly developed by the division and differentiation of its products. The nucleus and

sometimes the whole egg with it, divides into 2, 4, 8, 16 parts in geometrical ratio. The resulting cells however do not separate as in the lowest forms of life, but remain united, and do not long continue alike but become differe tiated. A very complex physiological division of labor is finally established among them, and when the adult condition is reached, the body is a colony of probably many million of cells, constituting various tissues and organs, all of which work correlatively and harmoniously for the good of the whole. The adult healthy body may thus be compared to an ideal state, where the cells represent individuals or individual minds, all of which have the same faculties, although developed in different degrees. Yet all these subordinate units work together in a wonderful way for the good of a higher unit, the body or state. As the state has its executive and police officers to guard its interests and enforce obedience to its laws, so the body has the nerve cells of the nervous system, which in health regulate and coördinate the working of all the other organs.

This fundamental conception of living things, known as the Cell Theory, was announced 50 years ago. It is no longer a theory but a fact, and from it every problem in biology must proceed.

How then is it possible to follow these delicate and intricate processes by which the complex cell-state or community, which we call the animal, is developed from the egg? The changes are chiefly internal, while the eggs, which are usually of microscopic size, are frequently opaque, and the protoplasm or living matter of the cells themselves, is colorless. Difficulties such as these, however insurmountable they may have been a generation ago, have been completely overcome, and it is now an easy task to divide an egg, which we will say is 1-25 of an inch in diameter, or the size of a pin's head, into a series of 100 sections, each 1-2500 of an inch in thickness. These may then be placed in serial order on a strip of glass, and each of the 100 sections, which can now be studied with high powers of the microscope, is seen to be a picture in color, which plainly tells of the marvellous processes which have

been going on unseen in the colorless living protoplasm of the cells.

The eggs of our Shrimp are taken at short intervals during several days or weeks, so that the series will represent the whole history of growth from the egg to the young prawn. The ova are then killed and hardened by suitable reagents, and finally preserved in alcohol. They are then stained with certain dyes like carmine, hæmotoxylon, or osmic acid (which both kills, hardens, and stains protoplasm at the same time). A great step was taken in modern biology (and especially embryology) when it was discovered that protoplasm has such a remarkable affinity for the aniline and vegetable dyes. The colorless and invisible can be made to yield the secret of hidden change in colored pictures. Furthermore it is probable that certain kinds of protoplasm, or protoplasm in certain stages combines only with particular dyes.

The stained eggs are then saturated with paraffine and embedded in a block of this substance. The paraffin block is clamped in the holder of a microtome, an instrument for cutting very thin sections, and then, thanks to the property of the paraffine, each section, as soon as cut by the passage of the knife, adheres by its edge to the section following, so that a paraffine ribbon can be cut, a yard long if necessary, in which the embedded egg will now appear in the form of a series of very thin colored sections, arranged in serial order. It is then a simple matter to fix them upon a glass slide, to remove the paraffin, and to seal the whole in a drop of balsam. Thus may we bring out the hidden writing and read the secret manuscript.

We have not the time to follow in any detail the life history of an animal like the Shrimp, however interesting it might be, to see how from the simpler the complex arises, how the adult with its tissues and organs each so remarkable and often complicated in itself, arises from comparatively simple beginnings, and how the individual in its own life history repeats in an abbreviated and modified form, the history of the race. But we do well if we realize this wonder of wonders, the development

of the higher animal with its marvellous organs, the eye, the heart and brain from the egg cell. If the eye or the brain is complicated, what must we say of this unicellular germ, the egg, in which in large measure certainly, the adult structure must potentially exist.

Some may think that since the young of different animals are subjected to peculiar conditions, to varying climate, food and the like, their differences in structure may be influenced by their surroundings. But this objection is easily answered, for we can rear the eggs of such diverse forms as the fish, the sea urchin, and the oyster in the same tumbler of water, where the conditions are identical. We are thus brought face to face with the great problem of *heredity*, that is, the law by which all living things tend to resemble the parents from which they sprung, or some ancestor belonging to their immediate race, in spite of variability or adaptation to environment. That the coral polyp reaches a certain stage of development and stops, that the starfish travels by this same road but advances far beyond, the young always coming to resemble the adult; that the higher animals pass still farther along this path; that the child resembles its parents often to a trick of speech or to a shade of mental or moral character, or that sometimes the character of a preceding generation makes its appearance, is one of the most remarkable phenomena which man has observed. Marvellous as it is, it seems not to be inscrutable, and the studies of recent years are lightening its dark passages.

It may be asked, of what use is the knowledge of the structure and development of animals below man. The chief aim in natural science is to discover relations. The life history of a coral is valuable for the light it throws on the problem of all organic life. The great laws governing all living matter are the same. We can only read the complex through the simple. The lower we pass in the scale of animal and plant life, the simpler the structure, the more nearly are the problems reduced to lowest terms.

The most interesting object in nature is man, and apart from the high claims of pure science, of knowledge for its own merit,

our studies naturally come to a focus in man. The history, the welfare and the destiny of man are questions which interest all civilized people.

Biology or the natural history of living things deals with the phenomena of organic nature, and to man, its central figure it constantly returns. Morphology, the study of structure, physiology the study of function, pathology the study of disease, and medicine the study of treatment go hand in hand, and are mutually dependent. We sometimes hear well meaning though misinformed persons speak of naturalists who spend laborious years of travel and devote their lives to research as if they were bitten with the mania of discovering new species. This is, of course, a great mistake. The history of every science begins with the naming of things, but this day is long past, and as Agassiz said in one of his cabin lectures when on his way to Brazil in 1865: "This is now almost the lowest kind of scientific work." . . . . "The work of the naturalist, in our day, is to explore worlds the existence of which is already known; to investigate not to discover." . . . . "The discovery of a new species as such, does not change a feature in the science of natural history, any more than the discovery of a new asteriod changes the character of the problems to be investigated by astronomers. It is merely adding to the enumeration of objects. We should rather look for the fundamental relations among animals; the number of species we may find is of importance only so far as they explain the distribution and limitation of different genera and families, their relations to each other and to the world under which they live. Out of such investigations there looms up a deeper question for scientific men, the solution of which is to be the most important result of their work in coming generations. The origin of life is the great question of the day. How did the organic world come to be as it is?"

A generation has passed since these words were uttered, yet how true they still read! Much indeed has been accomplished in this period; the horizon of all science has widened. The germ theory of infectious disease has become a science and is

now revolutionizing the practice of medicine and surgery. Says a well-known physician "Looking into the future in the light of recent discoveries, it does not seem impossible that a time may came when the cause of every infectious disease will be known." . . . . "What has been accomplished within the past ten years as regards knowledge of the causes, prevention, and treatment of disease far transcends what would have been regarded a quarter of a century ago as the wildest and most impossible speculation." Embryology has been enriched by the discovery of new means of research. Some of the best work in physiology has been done. Darwin's theory of the origin of species has been tested as a working hypothesis, and been found fruitful in valuable results. The work of the naturalist by its application to the economic industries of the nation can appeal to all classes. The service of the Fish Commission and of the Entomological Bureau annually save the country from great losses, and add to its resources. Our valuable food fishes are artificially raised, and the depleted pond, river or sea coast can be stocked anew. The oyster can now be reared from eggs artificially fertilized, and the young lobster has this last year been safely transported across the continent, and planted on the shores of the wide Pacific.

But the study of nature has another and less serious side, and here I refer to out-door nature as well as to in-door pursuits. It adds pleasure to life. It gives a zest and object to every walk or ride which one takes in the open air, to every camping and hunting excursion to the woods. It lengthens life, or what is the same thing, our experience, because we see just so much more of this beautiful world. Many people think that science is not only difficult but dry. This is a sad mistake. The scientific treatises which Charles Lamb would class with books that are *not* book, may be tedious to the beginner, but the student is not restricted to these or to the musty folios of the past, in making his acquaintance with animal and plant life. Technical works are not intended to be read but, like dictionaries, they are useful to consult.

"Botany," says Sir John Lubbock, "is by many regarded

as a dry science. Yet without it one may admire flowers and trees as one may admire a great man or a beautiful woman whom one meets in a crowd; but it is as a stranger. The botanist" or "one with even the slightest knowledge of that delightful science—when he goes out into the woods or into one of those fairy forests which we call fields, finds himself welcomed by a glad company of friends, every one with something interesting to tell."

The faculty of observation, so preternaturally acute in some minds like Aristotle's or Humboldt's or Darwin's, is rudimentary or dormant in a very large part of mankind. Said Emerson "if men should see the stars but once in a thousand years how would they wonder and believe!" The cheapness of the pleasure may be fatal to its enjoyment. They see only the mud and soot, where the gold and the diamond lie. They have eyes but do not use them, and like Laura Bridgman are cut off from many of the enjoyments of nature. As Lubbock well says, many still "love birds as boys do—that is, they love throwing stones at them; or wonder if they are good to eat, as the Esquimaux asked of the watch; or treat them as certain devout Afreedee villagers are said to have treated a descendant of the Prophet—killed him in order to worship at his tomb."

The study of Natural History, or Biology, if we use the newer term not only awakens the mind by cultivating the faculty of observation, but widens our enjoyments and enlists our sympathies, giving us a new and human interest in the manifold living beings around us which hold life by the same tenure as ourselves. It also fits in well with those instincts which we seem to have inherited from primitive man, with hunting and fishing, and also with travel, the facilities for which were never greater than in our day, and with short vacations in the country, all of which it enhances in interest, and to all of which it insures success.

Says T. Digby Pigott, "Of all the poor creatures, whose fate it was to be strangled or battered to death by Hercules, there was only one who made a really good stand up fight, and at one time seemed to be fairly beating him. He was Antaeus,

the son of the earth. Every time that he fell and touched his mother—we should say 'ran out to the country'—he came up again with fighting powers renewed. It was not till Hercules found out his secret and held him up, never letting him fall—we should say 'stopped his Saturdays till Mondays out of town'—that he quite broke him down. It is a myth in which the wisdom of the ancients is written for our admonition, in whom the ends of the world have come, the lesson that the best cure for a tired head and irritable nerves is the touch of Mother Nature,—to escape from the din of the city, and the everlasting cry of 'extra specials,' and lose oneself if ónly for a day among the wild creation."

The life and structure of the simplest animal or plant is a marvel, the greatness of which we are utterly incapable to conceive, and one of the plainest teachings of everyday science is that mere *size* is no test of importance. One might suppose that the microscopic cell was too small to be taken into account at all and to spend days and nights in the study of such objects must be a stupid sort of amusement: But an Elephant is only an aggregate of these little cells, and the nefarious microbe or floating spore, so small that it takes the highest powers of the best microscopes to clearly discern it, and so light that it floats in myriads on the wings of the viewless air, it is also a cell, and unfortunatly for man, when breathed into his lungs may be capable of multiplying indefinitely, and producing terrible disease and death. The coral polyp, insignificant enough when contemplated singly, is able to girdle the globe, only give it the time and favorable conditions. The leaven however small, which is hid in the meal, will in due time leaven the whole lump.

The mountains were not upheaved in a day. The hills have been carried by the touch of the rain-drop, and the flow of the ice stream and river. The smallest fragment of coral rock, which is among the youngest of modern formations, is but a phase in the endless cycles through which all matter runs. The rain united with the carbonic acid of the earth and air divides the solid rock, and the rivers from the four corners of

the earth carry down the molecules of lime in a ceaseless current with the common sea, where says Dana "after circulating over thousands of miles and for unknown times, they are brought to light and rendered tangible again by the incessant labors of millions of minute living gelatinous bodies, and by these insignificant organisms the lime is built up again into masses almost rivalling the original in dimensions and importance, but losing in this, its new dress, all traces of its divine origin and divine age." Thus he says, "we may have rocks from the snow-covered summits of the Himalayas, the limestones of the burning plains of India, and the strata of inaccessible China, removed from their respective districts—into the great common receptacle."

Modern science teaches that the small has produced the great, that the earth as we now know it has been fashioned by forces which are in operation to-day. The small indeed may be the most significant, and size in the vocabulary of biology at least may be an unimportant term.

SOLENISCUS: ITS GENERIC CHARACTERS AND RELATIONS.

BY CHARLES R. KEYES.

THE genus Soleniscus was established by Meek and Worthen to include gastropod shells closely allied to the widely known Macrocheilus; and said to be distinguished from the latter chiefly by the presence of a single elevated fold on the columella and by being produced anteriorly into a short canal. The authors described under this genus but a single species—*S. typicus*. Miller,[1] however, in 1877, included also *Macrocheilus hallanus* Geinitz. Four years later White[2] described from New Mexico *S. planus* and *S. brevis*; and afterwards[3] referred to the genus five other species which had orig-

[1] Am. Palæ. Foss., p. 162.
[2] Exp. and Sur. west 100th Merid., Supp. to Vol. iii.
[3] Ind. Geol. Rep. for 1883.

inally been placed under Macrocheilus. Upon the characters mentioned, principally, Macrocheilus and Soleniscus have been separated. The former was considered to embrace all the Devonian and a few of the Carboniferous forms described under the genus; and the latter the majority of the American Carboniferous species, generally known under the other generic title.

Of Macrocheilus there have been described from Europe nearly fifty species; two-fifths of which are from the Devonian. From America thirty-four species have been named; of these five are from the Devonian, three from the Lower Carboniferous and the rest from the Coal Measures. The American Devonian forms are exceedingly rare; and nothing beyond the original descriptions is known in regard to them. With one exception, they have been, in all probability, erroneously referred to the genus. The species described from the Carboniferous of North America will doubtless be reduced, after a careful comparison, to one-half the number now recognized.

Macrocheilus was founded by Phillips[1] in 1841, and under it were enumerated *Buccinum breve* Sow., *B. imbricatum* Phillips, *B. acutum* Sowerby and three other species. Phillips, however, expressly remarked that the first two of these properly belong to other groups, and that he regarded the third form as more typical. *B. acutum* Sow. hence becomes the type of the genus; and was thus considered by de Koninck and other European writers. An examination of numerous specimens of *Macrocheilus* (*Buccinum*) *acutum* shows that the shell possesses a more or less thickened lip, and a prominent revolving fold on the columella. De Koninck[2] long ago recognized this fact, stating that "La columelle est garnie d'un pli oblique et quelquefois de deux; le second pli n'est que faiblement exprimé et ne s'observe bien que dans les échantillons d'une conservation parfaite." It thus appears that the form described as *Buccinum acutum* by Sowerby is in all respects a typical Soleniscus and that therefore that genus and Macrocheilus are identical.

[1] Palæ. Foss. Cornwall, p. 103.

[2] Desc. des Anim. Foss. de Belgique, p. 474. 1844.

But Phillip's term Macrocheilus was preoccupied by Hope, in 1838, for a genus of insects and therefore becomes unavailable. Conrad, in 1842, proposed Plectostylus for a group of fossil gastropods which evidently belonged to Macrocheilus; but this name also had been used by Beck five years before. In 1860, Meek and Worthen founded the genus Soleniscus, for certain paleozoic shells which now appear to be very closely related to the type of Macrocheilus. Inasmuch as the latter term had been previously used, Bayle, in 1879, substituted the name Duncania, which he subsequently[1] changed to Macrochilina. The generic title *Soleniscus* therefore takes precedence for the *Macrocheilus* group, typified by *Buccinum acutum* Sow., and *S. typicus* M. and W., the synonymy being as follows:

Buccinum Sowerby, etc., [*in part*] (*non* Linné).

1841. *Macrocheilus* Phillips. Palæ. Foss. Corn., p. 103. (*non* Hope, 1838, Coleoptera).

1842. *Plectostylus* Conrad. *Jour. Acad. Nat. Sci.*, Phila., Vol. viii, p. 275. (*non* Beck, 1837).

1860. *Soleniscus* Meek and Worthen. *Proc. Acad. Nat. Sci.*, Phila., 1860. p. 467.

1879. *Duncania* Bayle. *Jour. de Conchyliologie*, Vol. xix., p. 35.

1880. *Macrochilina* Bayle. Ibid., Vol. xx., p. 241.

If the assumed differences in certain characters of the Devonic and earlier Carboniferous species described under Macrocheilus are real, and are of sufficient import to separate generically this group from *Soleniscus*, as has been suggested, some other generic term must be employed to designate the group. In this case, Bayle's name Macrochilina might easily be made to answer; but it is very doubtful whether this would be expedient. A more advisable plan would be to transfer to other genera the several species described under Macrocheilus, but which perhaps do not properly belong there. In this way it is thought that Soleniscus will form naturally a very compact and easily distinguishable group, at least in so far as the American species are concerned, and apparently also the European.

Soleniscus consequently embraces paleozoic gastropods

[1] Jour. de Conchyliologie, (3), Vol. xx., p. 241. 1880.

having the shell fusiform or subovoid; the spire always acute; body whorl relatively rather large; aperture suboval, rounded anteriorly, angular behind; labrum thin; columella imperforate, and provided with a more or less distinct fold; surface smooth.

As observed by White, the twisted ridge on the columella is scarcely discernible in the perfect shell until the outer lip is broken away, when it is seen to become more and more pronounced as it passes inward from the aperture. By the removal of the lip the anterior portion of the shell seems more extended than in the unbroken specimen; and this feature was made unduly conspicuous by Meek and Worthen when they established the genus under consideration. Although seldom noticed on account of the apertural part of the shell being filled with matrix, a more or less well defined columellar fold is observable in the most of the hitherto called *Macrocheili*. This plication, very slightly developed in some forms, passes, in the various species, by imperceptible gradations into a conspicuous revolving ridge as exhibited in *S. typicus*. The callus of the inner lip varies so greatly, according to the state of preservation and the locality, that only in a general way can it be relied upon as of generic importance.

The following species, originally described as Macrocheili may be considered as properly belonging to Soleniscus:

S. typicus M. & W.
S. acutus Sow.
S. humilis Keyes.
S. kansasensis Swallow.
S. hallanus Geinitz.
S. planus White.
S. brevis[1] White.
S. (?) *attenuatus* Hall.
S. gracilis Cox.
S. klipparti Meek.
S. altonensis Worthen.
S. newberryi Stevens.
S. paludinæformis Hall.
S. carinatus Stevens.

With two or three exceptions, perhaps, the other described species of the fusiform group from the American Carboniferous are apparently synonymous with one or another of those here enumerated. The genus probably includes besides *S. acutus*

[1] *S. brevis* White is synonymous with *Macrocheilus ventricosum* Hall, but the latter was preoccupied by Goldfuss (*Pet. Germ., Dritter Theil*, p. 29, 1841-44).

Sow. the majority of European forms now known under Bayle's Macrochilina.

In America, Soleniscus is one of the most characteristic genera of the Upper Carboniferous. The forms fall naturally into two categories: (*a*) the elongate or fusiform shells; and (*b*) the subovoid or subglobose varieties.

Those of the first group predominated in the earlier part of the epoch, while those of the second were more abundant in the latter part. The fusiform species occur most plentifully in the bituminous shales immediately associated with the coal seams. This would indicate that these gastropods were marsh or brackish-water forms, rather than denizens of the open sea. The subovoid forms are more commonly found in calcareous strata and were probably more strictly marine than the other members of the genus. Aside from the apparent difference in *optimum habitat* the shells of the two sections present some distinctive structural features which, taking all things into consideration, may eventually warrant a generic separation. This might with advantage be done with the American species, but whether it could be satisfactorily applied to the numerous foreign forms has not, as yet, been determined. The shells of the first category, compared with those of the second, have the volutions much more convex, the spire greatly depressed, the body whorl relatively much larger, and the aperture correspondingly ample, while the columellar ridge is usually obtuse and sometimes scarcely defined.

EXPLANATION OF PLATE XX.

Figs. 1, 2, 3. *Soleniscus acutus* Sow. 4. *S. humilis* Keyes. 5. *S. newberryi ?* Stevens. 6. *S. gracilis* Cox. 7. *S. attenuatus* Hall. 8. *S. typicus* M. & W. 9. *S. attenuatus ?* Hall. 10. *M. primogenium* Conrad. 11. *S. klipparti* Meek. 12, 14. *S. brevis* White. 13. *M. intercalare* M. & W. 15. *M. ponderosum* Swallow. 16. *S. paludinæformis* Hall. 17. *M. texanum ?* Shumard. 18. *S. planus* White. Last five after White.

RECENT LITERATURE.

HAECKEL'S REPORT ON THE SIPHONOPHORÆ COLLECTED BY H. M. S. CHALLENGER during the years 1873–1876.—This report forms Part lxxvii. of the zoological series of reports, and consists of 383 pages and fifty lithographic and chromo-lithographic plates. The author's long-continued and elaborate investigations of living Siphonophoræ and medusæ in the Mediterranean, Atlantic and Indian Oceans have enabled him to make it a generic monograph of the class. He distinguishes seventy-five genera, all clearly defined and described at length, containing 245 species. The plates are exquisite; remarkable both for beauty and elaborate finish of detail.

The following synopsis shows the distribution of the species.

ORDER I. DISCONECTÆ.

Family.	*Genera.*	*Species.*
Discaliidæ	2	5
Porpitidæ	4	15
Velellidæ	3	16

ORDER II. CALYCONECTÆ.

Eudoxiidæ	8	28
Ersæidae	2	4
Monophyidæ	6	17
Diphyidæ	8	35
Desmophyidæ	2	2
Polyphyidæ	3	8

ORDER III. PHYRONECTÆ.

Circaliidæ	1	3
Anthoriidæ	2	3
Apolemiidæ	3	4
Agalmidæ	10	32
Forskaliidæ	4	11
Nectaliidæ	2	2
Discolabidæ	3	11
Anthophyridæ	4	9

ORDER IV. AURONECTÆ.

Stephaliidæ	2	2
Rhodaliidæ	2	3

ORDER V. CYSTONECTÆ.

Cystalidiæ	1	2
Rhizophyridæ	6	11
Salaciidæ	1	2
Epibulidæ	2	4
Physaliidæ	4	11

WHITE'S REVIEW OF THE FOSSIL OSTREIDÆ OF NORTH AMERICA,[1] and a Comparison of the Fossil Forms with the Living Forms.—This is a compilation of material already published, arranged to show the geological history of the oyster family, addressed rather to the general reader than to the special student. The author recognizes three genera, and a sub-genus among fossil forms, but groups all the living species under one genus—Ostrea proper. Mr. Ryder contrib-

[1] A Review of the Fossil Ostreidæ of North America, and a Comparison of the Fossil with the Living Forms. By Charles A. White, M.D. With Appendices by Prof. Angelo Heilprin and Mr. John A. Ryder. Extract from the Fourth Annual Report U. S. Geol. Survey.

utes as an appendix an interesting sketch of the life history of the oyster. Of the forty-eight plates which accompany the paper ten, are excellent drawings of living species, so that the reader can compare for himself the fossil and the recent forms. A second appendix, North American Tertiary Ostreidæ, by Prof. Angelo Heilprin, completes the review.

RUSSELL'S GEOLOGICAL RECONNAISSANCE OF SOUTHERN OREGON.[1]—This paper is the result of the author's own observations in this region, and his conclusions are summed up as follows :

"The rocks are almost entirely igneous. The basins are orographic valleys of the Great Basin type. During the Plistocene the excess of precipitation over evaporation was greater than at present. A number of the Plistocene lakes did not overflow. Many of the lakes which now occupy basins of extensive Plistocene lakes that did not find an outlet are either fresh, or hold but a small amount of mineral matter in solution. Many of the basins now occupied by arid deserts were then filled with lakes. No glaciers existed during the Plistocene period in that part of Oregon east of the Cascade Mountains, and south of the forty-fourth parallel."

The paper is illustrated by two excellent maps and several cuts of sections in different localities.

THE PELAGIC STAGE OF YOUNG FISHES, by Agassiz and Whitman.[2]—This memoir is a continuation of the papers on the young stages of osseous fishes commenced by Mr. Agassiz in 1877, and is devoted to descriptive sketches of the different fish eggs and young fishes that have come under the author's notice. As far as possible figures of the characteristic stages of each species have been given, and many of the sketches supplement those formerly published by Mr. Agassiz. There is added a synoptic table of the characters of various eggs and young fishes with reference to the plates where they are figured, which will enable the student to identify them with little difficulty.

WRIGHT ON THE SKULL AND AUDITORY ORGAN OF THE SILUROID HYPOPHTHALMUS.[3]—The object of this paper is to

[1] A Geological Reconnaissance in Southern Oregon. By Israel C. Russell. Extract from the Fourth Annual Report U. S. Geol. Survey, 1884.

[2] The Pelagic Stages of Young Fishes. By Alexander Agassiz and C. O. Whitman. With nineteen plates. Extract from the Memoirs of the Museum of Comparative Zoölogy, Vol. xiv., No. 1, Part i., 1885.

[3] On the Skull and Auditory Organ of the Siluroid Hypophthalmus. By R. Ramsay Wright, University College, Toronto. Extract Trans. Roy. Soc., Canada, 1885.

show that Hypophthalmus possesses an air-bladder connected with the auditory organ by intervention of a Weberian apparatus, formed of parts of the anterior vertebræ, modified after precisely the same plan as in the other siluroids ; but that the apparatus in question and air-bladder exhibit a reduction recalling that in the genera *Loricaria* and *Hypostomus*. It is enclosed by an extension of the occipital bone, which explains why it has been overlooked by naturalists hitherto. The author bases his conclusions on a series of sections, selections from which are represented in three plates which accompany the paper.

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Annual Report of State Geologist of New Jersey, 1888. From George Cook, State Geologist.

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Darapsky, L.—La Lengua Araucana. Publicado en la Revista de Artes y Letras. From the Author.

Derby, O. A.—Occurrence of Monazite as an Accessory Element in Rocks. Extract from Am. Journ. Science, Vol. xxxvii., Feb., 1889. From the Author.

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GENERAL NOTES.

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The soil of Nuhuroa and the other islands is coral with a little quartz. Nuhuroa contains the only perennial stream, which is voluminous, singularly fresh, and rises in the centre of the island, so that the writers suppose that a subterranean basin, fed from springs on Great Ke or even in New Guinea, must exist. The population of the group in 1870 was 21,000 but small-pox reduced it in 1881 to 19,456. The greater part of the people reside in Nuhujund. About a third are Mahometans. The group belongs to Holland, but is in the hands of a German Colonizing Society.

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BURMA AND MANIPUR.—Col. R. G. Woodthorpe has forwarded the Royal Geographical Society of London an account of his work in and around the little known district of Manipur, where 2,800 square miles were triangulated by his surveyor, Mr. Ogle. The Brahmaputra at this part of its course flows generally parallel to the hills which separate, first, Assam from Cackar, and then Assam from Burma. These hills, increasing in height, finally culminate in lofty peaks, which singularly enough, are not on the main range, but upon spurs running out from it. Saramethè, the loftiest of these, rises to 13,000 feet. Toward the south these hill ranges part Manipur from the Lushai country, and then separate Burma from Chittagoriq. Northeast, as far as the Patkoi Pass they form the watershed between Assam and Burma. Beyond Savamethi the peaks gradually diminish in height to Maium Peak, which is only 7,000 feet. Here a drop of 3,000 feet occurs, the range narrows, and the Patkoi Pass offers a

Bulletin No. 4. Penn. State College. Agricultural Station, July, 1888.

Campbell, J. P.—Biology and its Place in a Liberal Education. From the Author.

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means of communication between Upper Assam and Upper Burma.

At about 25°-20′ the Chindwin River receives the Tuzu, a considerable tributary, but the exact point of junction has not yet been observed. The Tuzu flows from the northeast, and its destination seemed problematical, since its valley appeared to be shut in on both sides by lofty peaks through which no exit was possible. Col. Woodthorpe, however, discovered that the river, after joining another stream coming from the southwest, turns off at right angles, and makes its way through a magnificent gorge between Saramcthi and another mountain 11,000 ft. high. The teak forests of the Chindwin River are very valuable, and are exploited by an Angle-Indian Company. King Thebaw's repudiation of his agreement with this company was one of the causes of the war that led to the annexation of Burma.

South of Manipur and West of Burma, lies a mass of lofty hills, inhabited by several closely allied tribes, among whom are the Chins.

AMERICA.—THE LIMITS OF VENEZULA AND BRAZIL.—Count E. Stradelli has furnished the *Bolletino della Societa Geographica Italiana* (Aug. and Sept., 1888, Jan'y, 1889) with an interesting account of his journeys in Brazil. The January issue contains the trip from Cucahy to Manaos. In the course of this article the dividing line between Brazil and Venezuela is given. This line commences at the principal source of the Memagui, an affluent of the Haguieni, which latter is a tributary of the Rio Negro. The point is 2°-1′-29.3′ N. latitude and 70°-34′-57.65″ W. longitude. Disputed territory extends farther west, but here the Colombian, Republic and Ecuador have claims. The boundary follows the watershed to 70°-20′-44.11″ W. longitude, thence goes to the sources of the Macacuny in 1°-12′-3′ N. latitude, and 69°-22′-35″ W. longitude, descends the Rio Negro to 78°-34′-18.50″ W. longitude thence goes straight to the Serro Cupy, and follows the water-parting by the Mountains Imeri, Tapyra Pecô, and Curupira. Hence it inclines to the north, following the Parima range which divides the basin of the Rio Branco from that of the Orinoco. At the Serro Maschiati, 4°-31′ N. latitude and 47°-9′-35″ W. longitude, it re-assumes the east and west direction along the Pacaraima range. It passes by Mont. Piauassu in 3°-32′-24″ N. latitude, between the rivers Uraricàparà and Auapira, and Mount Rorainia, and thence to the confines of British Guiana. Most of this boundary runs through an inhospitable and unexplored country.

FONTANA'S EXPLORATIONS IN PATAGONIA.—The Italian explorer Fontana seems to have added considerably to the knowledge of the rivers of Argentine Patagonia. The Stalufu or Stanlufu is identical with the Corcovado, runs over a very sandy bed and is bordered with thick forests of beech and pines, rarely interrupted by meadows. Slightly to the south of this river the Carrenliefie runs directly into the Ocean near Point Hualà. The Corcovado is a plentiful stream, fed in its upper course by *six* affluents, the principal of which is called by the natives Uncaparia. Forty-one less important streams were discovered, among them the Quemquemtreu, Maritea and Pichi-Leufu (*the orthography is Italian*) also six before unknown lakes.

GEOGRAPHICAL NEWS.—The latest Stieler's Hand-Atlas has a map of Africa in seven sheets, upon a scale of 1–10,000,000 with all the latest changes. *Petermann's Mitteilungen* (35 Band. 1889, iv.) gives a list of the principal authorities drawn upon.

O. F. EHLERS states that he could find no trace of the presence of a crater upon the summit of Kibo (Kilimanjaro) which he estimates at upwards of 6,000 metres in elevation.

W. J. ORCHER, British Vice-Consul at Cheng-Mai or Zimme, has made an excursion to Cheng-tung, a market and thoroughfare about 200 miles to the Northeast of the former place, situated on a platform some 2,700 feet above the sea. The soil around is poor and but little cultivated, and the place owes what prosperity it possesses to its position.

Dr. BAUMAN, who accompanied Dr. Meyer, speaks of the good climate of the mountainous country of Uambara, between Pangaua and Umba in East Africa. The land is a mass of crystalline rock, covered partly with forest, partly with savanna, in places without vegetation. The Wachamba are the principal people and build two sorts of villages, one on slight elevations in valleys, with two concentric stockades and circular fences; the other on almost inacessible heights. They are agricultural, and are nominally Mussulmens. The Wachugu to the north are a taller people, and speak a different tongue; their houses are similiar, but they are almost entirely pastoral.

H. JOHNSTONE states that the difficulties encountered by the Deutsche Ostafrikanische Gesellschaft are chiefly due to the

efforts made by that company to diminish the influence of the Banyans or East Indian merchants, who are the most honest and enterprising traders of these parts. The English company will take care to avoid this mistake. The number of East Indians now residing in Zanzibar amounts to 7,000. The Banyans proper antedate the Portuguese in these parts.

H. TROGNOTZ gives the following as the correct areas of the countries of South America according to the latest data:

Brazil	8,361,350	Peru	1,137,000
Dutch Guiana	78,900	Bolivia	1,334,200
French Guiana	129,100	Chili	776,000
British Guiana	229,600	Argentine Republic	2,789,400
Venezuela	1,043,900	Uruguay	178,700
Columbia	1,203,100	Paraguay	253,100
Ecuador	299,600		
			17,813,950

This is exlcusive of the Falkland and Galapagos Islands.

GEOLOGY AND PALÆONTOLOGY.

PRESTWICH ON UNDERGROUND TEMPERATURES.[1]—The author treats the subject solely from the geological point of view. He gives tables of temperatures of coal mines, of mineral mines, of artesian wells, and bore-holes, and of tunnels. After rejecting all doubtful and uncertain cases he obtains the following values for their several gradients:

	Thermometric gradient, per 1° Fahr.
Coal mines	49.5 feet.
Mineral mines	43.2 "
Artesian wells	50.0 "

The mean of the three thus gives a general thermometric gradient of 47.5 feet per degree. In view, however, of the many causes which have interfered with the value of even the best observations, the author thinks it may be a question whether a general average gradient of 45 feet per degree would not be nearer the true normal.

[1] On Underground Temperatures, with Observations on the Conductivity of Rocks; On the Thermal Effects of Saturation and Inhibition; and On a Special Source of Heat in Mountain Ranges. By Joseph Prestwich, M. A., F. R. S. Extract from Proc. Roy. Soc., 1886.

DAVIDSON'S MONOGRAPH OF RECENT BRACHIOPODA.[1]—During the last hundred years the recent Brachiopoda have attracted considerable attention, and a large number of valuable papers have been published upon them, but no satisfactory general monograph treating of the shell and animal *conjointly* has appeared. This omission Davidson has supplied. The literature of the subject is voluminous and the labor of collating and revising alone has been enormous, but the result is a book the student will appreciate. The descriptions are characterized by a clearness and precision that shows the master. The numerous plates drawn by the author are exceptionally fine.

To Miss Agnes Crane is due the credit of editing this able work. Previous to Dr. Davidson's lamented death Miss Crane had been studying the Brachiopoda under his guidance, and at his request the proof-sheets of this memoir were read by her on the author's behalf.

BARROIS' FAUNE DU CALCAIRE D'ERBRAY[2]—A large quarto of 346 pages and 17 plates. After a brief introduction, in which the author gives his views of the formation of the *Calcaire d'Erbray*, follow five chapters devoted respectively to the Stratigraphy; the Description of 200 Species of Invertebrate fossils found in the *Calcaire d'Erbray*; Discussion of Former Works on the Fauna of Erbray; a Comparison of the Fauna of *Calcaire d'Erbray*, with Equivalent Faunas of Other Regions; General Considerations on the Fauna of *Erbray*. In conclusion the author remarks: "Les calcaires on plutôt les récifs coralliens du Harz, d'Erbray, appartiennent pour nous, à l'étage Gedinnien; ceux de Bretagne et d'Espagne, à l'étage Coblenzien; ceux de Cabrières à l'étage Eifélien; ceux des Ardennes, aux étage Gèvétien et Frasnien. L'identité de leurs conditions de formation a pu, a dû méme dans certains cas, donner aux faunes suscessives de ces calcaires plus d'analogies entre elles, qu'avec les faunes synchroniques de faciès different."

GAUDRY SUR LES DIMENSIONS GIGANTESQUES DE QUELQUES MAMMI FERES FOSSILES[3]—A short paper in which the

[1] A Monograph of Recent Brachiopoda, by Thomas Davidson. Extract from the Trans. Linnean Soc. of London, Vol. iv., part 1, 1886.

[2] Faune du Calcaire d' Erbray. Par Charles Barrois. Contribution à l'Etude du Terrain Devonien de l'Ouest de la France. 1889.

[3] Sur les dimensions gigantesques de quelques Mammiféres fossiles. Par M. Albert Gaudry. Extrait des Comptes rendus des Séances de l' Académie des Sciences t. CVII, 1888.

author gives the following table of the comparative size of some of the fossil mammalia:

Premier rang.....*Dinotherium giganteum* du Miocene superieure de l'Attique.

Deuxième rang.....*Elephas antiquus* du quaternaire (phase chaude) des environs de Paris.

Troisième rang.....*Elephas meridionalis* du pliocene superieure de Durfort.

Quatrième rang.....*Mastodon americanus* du plistocene des Etats-Unis.

Cinquième rang.....*Elephas primigenius* du plistocene de Siberie (phase froide); et Eléphants actuels.

THE PLISTOCENE LAKE OF NEBRASKA.—Prof. J. E. Todd (*Proceedings Am. Association for Adv. of Science*) calls attention to several facts, hitherto unpublished, which indicate that eastern Nebraska, western Iowa, and south-east Dakota were occupied by a fresh water lake when the drift first began to be deposited in that region. The facts and considerations are as follows:

1. An extensive deposit of fine sand, containing a few fossil bones, overlain in some places by a lead-colored clay without pebbles, and some fossiliferous silt resembling loess, is found occupying much of the region, especially the lower levels. Ten localities were mentioned where these formations have been observed, the more notable being at Fairview, Dak., Mills Co., Iowa, and Lancaster Co., Neb. A large fossil claw of some gigantic mammal (*Megalonyx*) was shown, which was obtained from Mills Co., Iowa, in the sand below the drift.

2. The occurrence of a stratum of volcanic ashes in such position as to show that wide areas were occupied by still water, just preceding the deposition of the drifts in some parts and during it in others. The localities described and pictured were in Knox Co., Neb., and near West Point, Neb.

3. An objection which may be urged, from the depth of the channel of the Missouri River in this region, is removed by several facts which go to show that said channel has been wholly excavated since the glacial epoch.

(*a*). The rock under the present bed is unglaciated and unoccupied by drift deposits as has been recently demonstrated

by observations made in sinking piers of bridges at Blair and Omaha.

(*b*). The Missouri is still deepening its trough with every flood. This has been determined by soundings at such times.

This fresh water lake, from its time and location, may be quite confidently considered a portion of the great body of water which occupied the western plains during late Tertiary times, and which was named by King, Lake Cheyenne.

GEOLOGICAL NEWS.—GENERAL.—The Rev. B. Baron states his belief, derived from an examination of the flora, that Madagascar separated from the African mainland during or even before the early Pliocene. This agrees with the deductions of Wallace. Five-sixths of the plant genera occur elsewhere, but four-fifths of the species are peculiar. The central part of the island is mainly gneiss and other crystalline rocks, with a strip parallel to the main axis of the island, and roughly to that of the crystalline rocks of the continent. The sedimentary strata occur chiefly in the west and south, and comprise eocene, upper cretaceous, neocomian, Oxfordian, lower oolite, and lias. The highest elevations are topped with lava, which is mostly basaltic. There is no active volcano now upon the island.

CAENÖZOIC.—E. T. Newton (Geol. Mag.) describes some recent additions to the preglacial Forest-bed fauna; including *Cervus rectus* n. sp. He refers the bovine remains to *Bison bonasus*, and the phocine to *Phoca barbata*. The narwhal, beluga, and *Phocaena communis* are also added to the list.

Sig. Ristori describes a Scylla found near Verona, but not sufficiently well preserved to warrant the formation of a new species, though it evidently differs from *S. serrata* and *S. michelini*, M. Edwd., and also from *S. hassiaca* Th. Ebert. It is the only example of the genus yet found in the Italian Territory.

Sig. Ristori (Boll. Soc. Geol. ii., vii. 188) describes an Inuus, *I. caudatus*, from the Pliocene of the Valdarno. This species had previously been erected into the type of a new genus by Igino Cocchi.

Oreopithecus bimbolia Gervais, is declared by Sig. Ristori not to be an anthropoid ape, but to appertain to the Cynopithecinae. The example is from the Miocene of Montebamboli.

F. Bussane (Boll. Soc. Geol. ii., vii. 1888) describes a species of Ephippus to which he gives the name of *E. nicolosi*, discovered in the middle Eocene of Val Sordino, near Lonigo (Veronese). It is near *E. longipennis*, Ag., but has denticulated spinous rays in dorsal and anal.

From an examination of fossil plants found near Rome, G. Antonelli concludes that in the plistocene period the neighborhood afforded a good number of land and fresh water species, mostly of a woody nature, and identical with recent plants of the same district, so that the climate must have been much the same as now.

The Bolletine of the Geological Society of Italy, 1888, has an account of the pliocene foraminifera of Ca dë Reggio, by Mario Malogili.

G. Ristori describes some Lower Miocene crustacea of Piedmont, including a new Neptunus (*N. convexus*) and *Mursiopsis pustulosus*, nov gen. et. sp., also *Callianassa canaverii* and fragments of unnamed species. Mursiopsis belongs to the Calappidae, and has points of resemblance to Hepatus, Mursia, Lambrus, and Calappilia. The carapax is convex in front, reëntering at the sides, and straight behind, and is trilobed like Calappilia or Lambrus.

A new species of Clupea, from the Oligocene strata in the Isle of Wight, is described at length by E. T. Newton, in the *Quarterly Journal of the Geological Society*, February, 1889. As he is unable to refer the specimens to any known species, he proposes the name *Clupea vectensis*.

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—The palæopicrite[2] of Bottenhorn, Hessen-Nassau, consists essentially of olivine and augite, both of which have yielded interesting alteration products. The olivine, when fresh, is discovered in twins, whose twin-

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Brauns: Zeits. d. deutsch. geol. Gesell. xl., p. 455.

ning and composition plane is a clino-dome. Upon alteration it gives rise to the rare mineral webskyite[1] and tremolite. The former is found to be an intermediate product in the passage of olivine into serpentine. Its analysis yielded results which indicate for it a composition corresponding to H_2 (Mg. Ie) $Si_4O_4 + 2$ Aq, that is a hydrated olivine, with part of its magnesium replaced by hydrogen. Its specific gravity is 1.745. The augite of the rock is brown in color, and, like the olivine, gives rise to a peculiar alteration product. This is a green garnet with the composition:

Si	Fe_2O_3	Al_2O_3	Ca O	Sp. Gr.
34.95	30.12	1.77	33.29	3.977

With it is associated helminth. Pseudomorphs of serpentine after magnetite are described in the same rock. A pseudomorph of calcite after chrysotile is mentioned as occurring in chrysotile veins in a diabase from Amelose, and pseudomorphs of the same mineral after the olivine of this diabase are briefly alluded to. An interesting addition to the study of jade and nephrite has been made in the shape of an article by Messrs. F. W. Clarke and G. P. Merrill[2] on the chemical and microscopical characteristics of the materials composing some of the instruments on exhibition in the U. S. National Museum. Analyses, specific gravity determinations, and the study of thin sections of nineteen specimens lead the authors to the view that the jadeite and nephrite objects, which have been gathered from widely scattered localities, cannot be depended upon in the work of tracing the migrations of ancient tribes of people, since (1), the material of which the objects consist is by no means always a pure jade or nephrite, and (2), these substances themselves, when obtained from different sources possess very different characteristics. The analyses and microscopical studies yield little new in regard to the structure of true jade. The paper is of importance as affording proof of the existence of a true jade in Alaska, and as a record of the results of the examination of many jade instruments not heretofore described.

Near the village of Trevalga[3] is a shell of eruptive rock, from seventy to a hundred feet thick, interstratified with slates. Foliation is highly developed throughout its mass in a direction parallel to the cleavage of the slates. In places it is

[1] Cf. AMERICAN NATURALIST, November 1887, p. 1021.

[2] Proc. U. S. Nat. Museum, xi., 1888, p. 115.

[3] Hutchins: Geol. Magazine, Mch. 1889, p. 101.

coarsely laminated, a soft chloritic or micaceous material, alternating with layers of a hard, compact, non-foliated stony substance. The hard layers consist of calcite and feldspar in a mosaic of feldspar, chlorite, calcite, muscovite, secondary quartz, epidote, biotite, and iron compounds. The softer strata contain a great deal of chlorite and epidote is present, the other constituents remaining the same. The epidote is thought to have originated before the development of schistisity in the rock. Both layers have practically the same composition, and are therefore regarded as parts of the same magma. Both show evidences of the result of pressure in the case of their individual components. Only in certain portions, however, (in the softer layers) has this pressure produced foliation.—Ascension Island in the South Atlantic Ocean is entirely of volcanic origin. Its rocks embrace principally trachytes and andesites. The most widespread and the oldest of these, according to Renard,[1] is a pyroxene trachyte with a glassy base, which is locally so largely developed as to yield a trachyte-obsidian. In both phases little microlites of orthoclase are twinned according to the Carlsbad law, showing interpenetrative crosses in the thin section. By the assumption of hornblende the rock passes into a hornblende-trachyte, and by the local accumulation of silica a transition into rhyolite is noticed. The surface of the island is covered with scoriaceous basalts. In some localities an andesite occurs in which the augite is bronzite. Over several circumscribed areas the volcanic rocks contain, as inclusions, fragments of granite, diabase, and gabbro.—A few notes on the rocks occuring in the auriferous tracts of Mysore Province, South India, are communicated by Burney[2] as an appendix to an article by Attwood on the structure of the region. The rocks embrace eclogites, hornblende, and mica schists, all showing evidence of the effects of great pressure and also dykes of various eruptive rocks. The gold is found in quartz veins in the schists.—An interesting trachyte[3] from the Cumana railroad tunnel, near Naples, Italy, contains sanidine, two varieties of hornblende, and rod-like aggregates of hornblende and pyroxene in a ground mass of sanidine, amphibole, and magnetite. In the vesicles of the rock are large, colorless pseudo-hexagonal crystals of sodalite, rods of black amphibole, pyroxene, little crystals of sanidine,

[1] Bull. Mus. Roy. d. Belg. T. v., No. 1, p. 5.

[2] Quart. Jour. Geol. Soc., Aug. 1888, p. 636.

[3] Johnston-Lavis: Geol. Magazine, Feb. 1889, p. 74.

and tufts of a fibrous titanium mineral.—The alteration of an epidiorite into a chlorite schist is described by Hutchings[1] from Tintagel N. Corniwall. The epidiorte contains, in addition to the usual constituents of this rock, grains of colorless epidote, a little calcite, a very little quartz and some secondary feldspar. As schistosity is induced the amount of calcite, chlorite, and quartz increases, and epidote disappears, until finally a typical chlorite schist results.—Brief descriptions of the rocks of Somali Land, in Northeastern Africa, and of the island of Socotra are given by Miss C. A. Raisin[2] in recent numbers of the *Geological Magazine*. Those of the former locality are granites, hornblende, diabases, porphyrites, gneisses, and talc and epidote schists, overlain by limestones and other sedimentary rocks. On Socotra is a felsite with corroded quartz crystals, in which the included groundmass forms concentric rings separated by quartz material.—Ternier[3] describes very greatly corroded quartz crystals in a micro-granilite from Osaka, Japan. These crystals are surrounded by little islands of quartz with the same optical orientation as the larger grains, and the entire group is enclosed in a zone, composed of fibres of quartz and orthoclase, of which the former extinguish parallel to the large quartz crystal.—Wyronboff[4] has analyzed a specimen of the black, opaque, friable obsidian, with a fatty lustre, that occurs at Obock, and obtained the following result:

SiO_2	Al_2O_3	Fe_2O_3	MgO	V_2O	H_2O	Sp. Gr.
70.00	13.88	2.77	1.20	7.78	4.11	2.345

MISCELLANEOUS.—*Etched figures.*—It is well known that the character of the figures produced by etching a crystal of quartz with hydrofluoric acid varies with the nature of the crystal, and also with the symmetry of the face acted upon. With a knowledge of these facts, Messrs. Otto Meyer and Penfield have subjecte d a sphere of quartz to the influence of strong hydrofluoric acid, and have presented their results in a beautifully illustrated article. The difference in the case with which the acid etches various portions of a crystal of quartz is finely brought out by the shape which the sphere assumes

[1] Geol. Magazine, Feb. 1889, p. 53.
[2] Geol. Magazine, 1888, p. 414 and p. 504.
[3] Bull. Soc. Franç. de Min., xii., p. 10.
[4] Bull. Soc. Franç. d. Min. xii., p. 31.
[5] Trans. Connecticut Acad., viii., 1889, p. 158.

after prolonged action of the etching agent. It is found that the acid acts very unequally on different parts of the sphere, corresponding to the different crystallographic faces of the crystal from which it was cut, but equally with reference to the system of hexagonal axes. In this way the tetartohedral symmetry of the mineral is strikingly revealed. The action is greatest at the two extremities of the vertical axes, while at the ends of the lateral axes it seems to be almost nil. As a final result of the action of the etching agent the sphere is reduced to a lenticular body with a triangular cross section, with the three angles of the triangle at extremities of the lateral axes.—A comparison of the shapes and positions of the etched figures produced on halite and sylvite upon their exposure to moist air has been made by Brauns.[1] Those in rock salt are usually bounded by the planes of a tetratis hexahedron, which may vary in formula between $\infty O \frac{5}{4}$ and $\infty O \frac{21}{2}$. Occasionally a depression bounded by the planes $\frac{1}{4} O$ is $\frac{1}{3}$ observed. In both cases the position of the figures on the faces etched are such that they possess the same planes of symmetry as does the face upon which they are. On sylvite, on the other hand, the depressions have no planes of symmetry in common with those of the crystal face. Halite is therefore regarded as holohedral, while sylvite is gyroidally hemihedral. The same writer mentions the existence of twinning strialtuis on cleavage pieces of rock salt, whose twinning plane is 20 O.

NEW BOOKS AND PAMPHLETS.—"Les Mineraux des Roches"[2] is the first French book that treats of optical properties of minerals in a way to be of use to students in the study of thin sections of rocks. As the authors state in their preface, the new book is a natural complement to Fouqué and Lévy's "Mineralogie Micrographique." In the first part the author (Lévy) discusses the application of the principles of optical mineralogy to the study of minerals in thin sections of rocks. The methods made use of in this discussion are somewhat new to petrography, as they are based more upon mathematical considerations than is usual. The fundaments of crystallography and of optical mineralogy are presupposed, as is also a knowledge of spherical geometry and trigonometry. After deducing the mathematical relations of the optical axes and bisectrices, the curves of extinction in the principal zones

[1] Neues Jahrb. fur Min., etc., 1889, i., p. 114.

[2] "Les Mineraux des Roches," par Michel Lévy et Alf. Lacroix. Paris, 1888. Baudry et Cie. 218 fig., 1 pl., pp.

of monoclinic and triclinic minerals are constructed, in the manner familiar to the readers of the "Mineralogie Micrographique." The development of the laws of double refraction and pleochroism, etc., follow, and the facts thus developed are graphically illustrated by diagrams. A special feature of this portion of the book is a large, lithographic plate, by means of which the nature of the substance composing a crystalline particle of known thickness may be determined by noticing its color between crossed nicols. The general portion of the book concludes with an excellent chapter on microchemical reactions.

In the special portion, (by Lacroix), the chemical, morphological, and physical properties of a large number of minerals are given in concentrated forms. The appearance which these minerals present in the thin section, and their general characteristics, however, are not described, so that the book is in reality a text-book in optical mineralogy. The features which have made Professor Rosenbusch's "Mikroskopische Physiographie" so invaluable as a guide to the detective minerals *in rocks* are lacking in the volume before us, but many of those in which the latter is wanting are found in the former in good quality. "Les Mineraux des Roches" is really a complement to Rosenbusch's work, supplementing it in those very portions where the "Mikroskopische Physiographie" is weak. It is unnecessary to remark that the book of Lévy and Lacroix is one to be placed in the hands of a beginner in the study of optical mineralogy, although it will prove of inestimable value to him who is already familiar with the general principles of the science.—Mr. Eyerman[1] has collected in a pamphlet of fifty-four pages descriptions and notices of the new minerals and new mineral occurrences that have been discovered in Pennsylvania during the fourteen years since the appearance of Dr. Genth's "Preliminary Report on the Mineralogy of Pennsylvania." The analyses of Pennsylvania minerals that have been published during this period are reproduced, and a few original observations of new occurrences are given. Authorities are quoted in all cases, so that the pamphlet is of great value to anyone interested in the minerals of Pennsylvania.—The "Catalogue of a Collection of Precious and Ornamental Stones of North America, Exhibited at the Paris Exposition, 1889, by Tiffany and Co.,[2]" contains a very complete list of

[1] "The Mineralogy of Pennsylvania." Part i., Eastern Pa.

[2] New York. The De Vinne Press. 32 pp.

the valuable minerals and gem materials of North America, numbering, in all, three hundred and fifty-two specimens.

BOTANY.[1]

AS REGARDS SOME BOTANICAL LATIN.—Scientific Latin is often said to be the laughing-stock of philologists. This may not concern botanists very much, as they do not require anything but scientific usefulness of their Latin. Nevertheless, if they are to use Latin, it is best that they use good Latin, especially as that is not a matter of very great difficulty. A principal source of inaccuracy in botanical Latin is the fact that a large number of names had their origin in the last century, or even earlier, when impure, medieval Latin was dominant. Then modern botanists, in attempting to give these names classical forms, often make them still worse. Besides, scientific men are not always as good philologists as they should be, so that many modern names are faulty.

Whether medieval Latin should be retained in Botany, on account of its antiquity and long use, or the purer forms should be substituted, is no part of the present consideration. But I may say in passing that the Latin studied and written for the most part to-day is classical Latin, and for this reason attempts to retain eighteenth century forms are liable to result in inaccuracy and absurdity.

Some of the principal characteristics of eighteenth century Latin are the use of ch for c and y for i in many words, in imitation of the Greek, and the use of the feminine nominative form for the masculine in adjectives like campester and palustер. On the continent Pirus has largely replaced Pyrus for some time, and this spelling has been followed to some extent in this country. English authors retain the eighteenth century spelling. But as is usually the case in changes of this kind, authors are inconsistent, changing some forms, and retaining others capriciously.

Of German authors, Luerssen writes Pirus, Pirola, silvester, etc. Frank (in Leunis, Syn. der drei Naturreiche) uses classical forms throughout. Drude (in Encyklopaed. der Naturwissenschaft.) writes Pirus, but sylvestris. Koch (Dendrologie) does the same. Sachs seems to prefer classical forms, but

[1] This department is edited by Professor Charles E. Bessey, Lincoln, Neb.

uses both. Winter uses eighteenth century forms as a rule, but his lacrymans is a hybrid.

Saccardo (Syl. Fung.) uses classical forms as a rule, but, probably from carelessness, is very inconsistent. He writes Piri, Pirolæ, campester, paluster, silvester. But sylvatica and sylvana! He has sometimes lacrymans, and sometimes lacrimans.

French authors usually prefer Pirus—but sylvestris and sylvatica. Vesque, however, has Pyrus.

Of American authors, Gray always consistently uses eighteenth century forms. Watson (Index and Botany of Cal.) writes Pirus; but sylvestris and sylvatica, and, curiously enough, the diminutive Pyrola. Coulter uses eighteenth century forms as a rule, but has the hybrid sylvester. Britton uses eighteenth century forms consistently.

It will be noticed that those who retain the eighteenth century Latin do so consistently, while those who attempt to substitute classical forms do it capriciously and without system. There seems no good reason for this, and it is probably largely due to carelessness. At any rate, if Pyrus is to be spelled with an i, so should sylvaticus, sylvanus, and sylvestris, and the latter should have the termination ter. If eighteenth century forms are to be retained we should write lachrymans; otherwise lacrimans. We cannot split the difference in this matter.—*Roscoe Pound.*

THE PRONUNCIATION OF SCIENTIFIC NAMES.—The following are the rules for the pronunciation of scientific names, adopted by the Botanical Seminary of the University of Nebraska.

I. In general, all names of the branches, classses, orders, and families of the vegetable kingdom, and their subdivisions, and the names of all genera and species shall be pronounced according to the "Roman Method."

II. Generic and specific names derived from un-Latinized personal names may, if difficult to pronounce as Latin, be pronounced according to the rules of the language from which they are derived. But even in these cases the Roman pronunciation is recommended if it can be used.

III. Latin words which have become Anglicized shall be pronounced as English.

IV. The following is a conspectus of the Roman Method:

1. VOWELS.
   A, long as in German; short as in ideă.
   E, long as in German; short as in English (ănd).
   I, long as in German; short as in English (it).
   O, long as in English; short as in obey.
   U, long as in boot; short as oo in foot.
   Y, as I.

2. DIPHTHONGS.
   Ae (ai) as long i in English,
   Au as ow in now.
   Eu as ew in few.
   Oe (oi) as oy in English.
   Ou (ow) as long u (Roman).
   Ui as we in English.
   Ei as in eight.

3. CONSONANTS.
   C and G *always hard.*
   S always sharp; never like z.
   J like English y.
   U like English w.
   Bs like ps.
   Ch like k.
   Th always as in thin; never as in then.
   Others as in English.

4. QUANTITY AND ACCENT.
   (1) A vowel before another vowel or *h* is short.
   (2) A diphthong is long.
   (3) A syllable in which a vowel is followed by two consonants or a double consonant is long. Before nf, ns, gn, or gm the vowel itself is long.
   (4) A syllable in which a short vowel is followed by a mute with *l* or *r* is common.
   (5) Words of *two* syllables are always accented on the *first.*
   (6) Words of *more than two* are accented on the *penult* if it is *long;* if it is *short* or *common,* on the ***antepenult.***

5. SYLLABLES, ETC.
   (1) Each vowel or diphthong constitutes a syllable.
   (2) Every syllable should be pronounced.
   (3) When a consonant is doubled or two come together, each should be pronounced.

THE "ROMAN PRONUNCIATION" IN HORTICULTURE.—Since the foregoing paper was received, the final volume of "Nicholson's Illustrated Dictionary of Gardening" has come to hand, and in it we notice with pleasure the article on the pronunciation of ordinal, generic, and specific names, by Percy W. Miles of the University of Dublin. After remarking upon the "chaotic state" of the pronunciation of the scientific names of plants, the writer observes that "the way in which many gardeners make havoc with the names of plants has been a frequent subject of satire with philologists and other writers." And again "the manner in which Latin has been, until lately, pronounced in this country is thoroughly inaccurate and unscientific, and so entirely insular that in speech it is often quite

unintelligible to foreigners, even to those who are good Latin scholars. As one of the chief advantages of the uniform Latin nomenclature of plants is that thus a sort of universal or international language is created, it is evident how much has been lost by our prejudiced adherence to a provincial mode of pronunciation."

After much consideration and consultation with several eminent botanists, the writer determined to follow the Roman system of pronunciation in his article. He proceeds to give the essentials as to accentuation, quantity, and the pronunciation of particular letters, practically as given in the rules set forth above.

"It will be as well to guard the reader against the supposition that there exists at present for botanical names any recognized standard of pronunciation from which he may imagine that this dictionary often presumes to depart. The fact is that there is no such established standard. In many cases the common text-books are utterly at variance, and the usage, not only of good gardeners, but of educated botanists is often hopelessly divergent."

In but one point of importance, (and that is in fact of but minor importance,) are the rules different from those printed above. Mr. Miles says that *in all cases* of words commemorative of the names of men, we should pronounce the word "as nearly as possible in the way in which the name to be commemorated was sounded." Thus he would have us say *Stokes-i-a*, not *Sto-ke-si-a*, *Men-zics-i-i*, not *Men-zi-es-i-i*. We are of the opinion that the rule of the Seminar, given above, is preferable, and will in the end lead to the best results.—*Charles E. Bessey.*

ZOOLOGY.

SOME CASES OF SOLID-HOOFED HOGS AND TWO-TOED HORSES.—In 1878 "soliped" pigs were reported from Texas. Dr. Coues observed that in the new breed the terminal phalanges of the toes were united, to form a single broad phalange; above this, however, the other two phalanges remained perfectly distinct. The hoof is perfectly solid, and on its sole there was a broad, angular elevation of horny substance, curiously like the frog of the horse's hoof. The breed was so firmly established that no tendency to revert to the original and normal form was then observable. It was further stated

that, in the cross of a solid-hoofed boar with a sow of the ordinary type, a majority of the litter has the peculiarity of the sire apparent.

There has just been reported to me from Sioux City, Iowa, (famous for its annual "corn palace") a similar case. Indeed, it would seem as if the owner was quite alive to their rarity and had been breeding them for some time, and had now as many as induced him to advertise them for sale, "not alone for being a curiosity, *but in a commercial sense a valuable production for mankind!*" The owner continues: "The experience of the writer convinces him that there is no better hog for the healthy growth of pork. These hogs are of long body, and have well proportioned hams and shoulders. It is true they have not the fine head of the 'improved' breeds. . . In size they are fair, a couple of barrows (accidently castrated) now near thirteen months old, without special care weigh over 350 pounds each. As yet there has been no sign of any loss from disease whatever (though diseases have been common in that district for years). A few boars, six to eight weeks old, will be sold . . . ." etc.

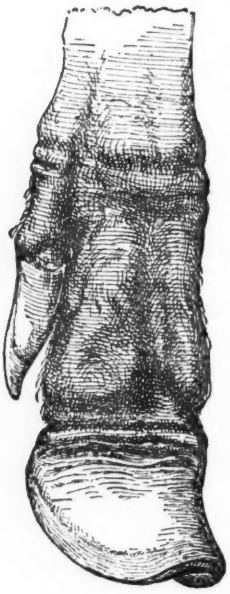

Fig. 1. Solid-hoofed Hog.

We are making further inquiries into the above, and will report results.

But it seems quite evident that these "mule-footed" hogs are of frequent occurrence in America. Some "get into print," and some don't. For instance we are obliged to the *Rural New Yorker* for two more cases. A known correspondent to that excellent periodical writes thus, from Cottonville, Louisiana, in the issue for September 22d: "As a curiosity which I never saw before, or even heard of, I send the foot of a 'mule-footed' hog. There is a herd of them ranging the woods, about eight miles north of Baton Rouge. None of the old settlers can give me any further information concerning them than "that they are a herd of wild hogs.'" An exact drawing is published with the above, which is enclosed for your reproduction. (Fig. 1.) The editor adds a note to

the above: "We have seen several of these 'mule-footed' hogs. In a small Southern town, a large Poland-China boar had one hind foot exactly like the one shown in our picture, and a large proportion of the young pigs from him were marked in the same way."

We have also had undoubted cases of extra-toed horses reported here. During the summer of 1885, *The Advertiser*, Constantine, this State, contained the following: "On Wednesday night of last week a mare belonging to Mr. Fred Hagenbuch, of Fabius, gave birth to a male colt, well formed and perfectly symmetrical in all respects, except that one of the feet is cloven and hoofed like the foot of a cow. Who has a mate for this colt?" This was quoted in *Breeder's Gazette*, Chicago, the leading breeder's paper of America, and brought out a response from Mr. N. C. Woolf, in issue for July 16th, thus: "My neighbor, Mr. D. M. Hall, has a two-year-old colt that exactly fills the above description. For a few months Mr. Hall has taken great pains in shoeing, and thinks he will succeed in making a pretty good hoof."

These cases are, I think, of sufficient interest to entitle them to be rescued from the oblivion that they must experience. And they are, I think, of sufficient value to have a place accorded them in THE NATURALIST.—*R. C. Auld*, Pinckney, Michigan, U. S. A.

INTERESTING CASES OF COLOR VARIATION.—As a contribution to the increased interest attaching to the recent discussions of color variation in animals, as bearing upon the problems of natural selection, the following may not be without value. The first is that of some remarkable variations in color in the common robin, Merula migratoria. Some two years ago, in the Spring of 1887, while studying the habits of this bird, strolling almost daily into their haunts, I was much struck by what at first appeared a strange bird among a group of robins. A moment's attention, however, disclosed the true character of the stranger, and showed it to be strange only in the matter of color, which was a motley of white and gray on the head, neck, shoulders and back. Though having no means of securing the specimen at the time, an attentive study of the marking showed that it could not be a case of albinism, as is so often the case in such variations. The bird was not seen for that time only, but I saw the same specimen a few days later, and then repeatedly during the Spring, as it proved to be a female, and nested near my home. No propagation of the variation appeared in the offspring that was appreciable.

The following Spring I noted evidently the same bird in the same locality, and at about the same time in the season. It remained in the neighborhood during the Summer, again nesting. In neither season did there appear any signs of transmission of the peculiarity to the offspring.

A robin similarly marked was noted by Mr. Amos. W. Butler, and reported by him through the Journal of the Cincinnati Society of Natural History. Altogether, the cases seem rather anomalous and outside the usual causes involved in such variation.

Another case of similar character came under my observation later. In the Spring of 1888 I captured two *moles, Scalops aquaticus* (?) on my lawn, both of which had markings of pure white on the neck and belly. In another specimen, only the skin of which I saw, but which was taken in the neighborhood, the white extended on one side to the back in irregular blotches, giving to the skin a strangely variegated appearance. As is well known, the color of this mammal is quite constant, and of a dark plumbeous or slaty hue, slightly lighter below. I have seen no record of a tendency to vary in the manner noted above, or indeed in any way in particular. The usual color is, of course, quite in keeping with its habits and environment, and in so far might be assumed as the result of natural selection. But how are we to account for these peculiar variations? Are they the expression of a tendency to revert to a primitive or to an ancestral type, or are they not rather in keeping with what is so often seen in plants as well as in animals under changed conditions, due to causes obscure in their nature and as yet very imperfectly understood? The recent discussions of these matters by Agassiz, Riley, and others, and the reference of Mr. Adam Sedgwick in a recent number of *Nature*, to the remarkable coloration in Peripatus, when its habits are taken into account, seem to lend great plausibility to the principle of "Saltation," or sudden and obscure variation.

Altogether, there seems reason for moderation in reference to *any theory* as yet proposed. Evidently, the evidence is not yet all in.—*C. W. Hargitt*, Miami University, Mar. 25, 1889.

THE BALD CHIMPANZEE.—Dr. P. L. Sclater describes in *Nature* (1889, p. 254), a couple of female apes from tropical West Africa, which resemble the chimpanzee, and yet differ in marked features. The ear is much larger, and the hair is generally sparse, so much so on the head as to permit the application of the term bald. The color of the face is blackish. In

the chimpanzee the head is thickly clothed with hair, the face is flesh-colored, and the ears are smaller. Both these animals (which are in the London Zoological Garden) are carnivorous, catching and eating sparrows and pigeons. It is stated that this is never done by the chimpanzee. Dr. Sclater provisionally refers these animals to the *Anthropopithecus calvus* of Du Chaillu.

ZOOLOGICAL NEWS.—CŒLENTERATA.—Dr. H. V. Wilson records (*J. H. U. Circ.*, No. 70) that in *Cereactis bahamensis* the mouth occasionally grows together in the middle, leaving oval and anal openings at the ends. He also found a single larva of *Manicina areolata*, which exhibited the same peculiarity. In this connection reference is made to Sedgwick's celebrated paper on Metameric Segmentation.

In the same place Prof. J. P. McMurrich gives a list of the Actinaria of New Providence, enumerating fourteen species, of which *Cereactis bahamensis*, *Bunodes tæniatus*, *Aulactinia stelloides*, and *Gemmaria isolata* are new. The fact is also recorded that *Aulactinia stelloides* passes through an Edwardsia stage when eight nusenteries are present and the longitudinal muscles are arranged as in that genus.

ENTOMOLOGY.[1]

OBSERVATIONS ON ANTS, BEES, AND WASPS.[2]—Sir John Lubbock has published the eleventh part of his observations. He is of opinion that, though there may be nests of *Formica sanguinea* without slaves, an experiment which he has made seems to indicate that the slaves perform some important functions in the economy of the nest, though it is not yet determined what that function exactly is.

With regard to Ant-guests, he points out that Dr. Wasman has confirmed his observations, in opposition to Lespès, that, while ants are deadly enemies to those of other nests, even of the same species, the domestic animals may be transferred from one nest to another, and are not attacked. Attention is next drawn to Professor Emery's observations on mimicry among ants.

With regard to the color sense, Professor Graber has confirmed Sir John's observations on Ants and Daphnias, by

[1] This department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] Journ. Linn. Soc. Lond., xx., (1888) pp. 118 36. 1889.

which he showed that they are sensitive to the ultra-violet rays, by similar observations on earth-worms, newts, etc. Light was found to act on decapitated earth-worms, though the differences were not so marked; the same held good for newts, when their eyes were covered over, and Graber hence concludes that the general surface of the skin is sensitive to light. Forel has made some observations on ants, the eyes of which were carefully covered by opaque varnish, so that they were rendered temporarily blind.

From experiments made with Platyarthrus, which have no eyes, the author found that they made their way into the shaded portion of a partly covered nest, and he remarks that it is "easy to imagine that in unpigmented animals, whose skins are more or less semitransparent, the light might act directly on the nervous system, even though it could not produce anything which could be called vision."

Sir John's experiments lead him to differ from M. Forel, who believes that bees have a certain sense of direction. The power of recognizing friends is discussed at some length, but the explanation of the fact still remains obscure. The most aged insect on record is a queen of *Formica fusca*, which lived for fifteen years; what is much more extraordinary is that she continued to lay fertile eggs; fertilization took place in 1874, at the latest, and there has been no male in the nest since then, so that the spermatozoa of 1874 must have retained their life and energy for thirteen years.

The seeds of *Melampyrum pratense* are, as Lündstrom has recently pointed out, closely similar to the pupæ of ants, and he has suggested that this may be an advantage to the plant by deceiving the ants, and thus inducing them to carry off and so disseminate the seeds. The author's own observations show that *Formica fusca* appears to take no notice of these seeds, but that, under certain circumstances, they are carried off by *Lasius niger*.

The observations of Mr. and Mrs. Peckham, on the special senses of Wasps, is referred to as containing conclusions which concur closely with those of Sir J. Lubbock.

A connected account of the author's observations is given in a recent work, "On the Senses, Instincts, and Intelligence of Animals, with Special Reference to Insects,"[1] which will be found useful as a handbook of the subject with which it deals. —*Jour. Royal Micr. Soc.*, 1889, p. 49.

BASAL SPOT ON PALPS OF BUTTERFLIES.[2]—Herr. E. Reuter states that in all the species of butterflies (between two

[1] 8vo, London 1888, 292 pp., 118 Figs.

[2] Zool. Anzeig. xi., (1888) pp. 500-3.

and three hundred) which he has examined there is at the base of the inner surface of the palps a naked spot which can be always easily seen. He consequently regards it as typical of the order.

It is generally well defined and ordinarily occupies the basal half of the first joint of the palp. The rings or furrows discovered by Landois are always present, though often indistinct or incomplete. When present, they ordinarily occupy the greater part of the basal spot, and are more or less parallel. They are best developed on the part of the surface which, in the natural position of the palps, is directed upwards and inwards ; it is this part which is most commonly pressed against the basal part of the proboscis, which is provided with a raised ridge.

In addition to these rings there are peculiar forms of hairs which do not seem to have ever yet been described. They are conical in form, chitinous, are surrounded at their base by a circular membrane; they are all connected with nerve-fibers, on which, just before they enter the cone, a ganglionic swelling can be seen. There are several hundreds of these cones, and, in addition to them, there are immense numbers of similar, but much smaller, conical bodies. In the Micro-lepidoptera there are sometimes also pits or pores, and sometimes these are alone present.

There can be no doubt that we have here to do with specific sensory organs, but what is the special sense we do not know. The author is inclined to think that it is of an olfactory nature. The cones exhibit the greatest variability and highest grade of development in the Rhopalocera, and their variations may be of use in the definition of families and genera. In the Butterflies proper, the organ in question is always much larger and better developed in the male than in the female.—*Jour. Royal Micr. Soc.*, 1888, p. 943.

PARASITE OF COSMOPOLITAN INSECTS.—Under the title of "A Commencement of the Study of the Parasites of Cosmopolitan Insects,"[1] Mr. L. O. Howard gives a list of nearly 100 insects, common to the Old World and the New, together with a list of the European parasites of each, and a second list of the American parasites of each. This paper presents us with a large amount of information in a very compact space, and we hope it is only a forerunner of a more extended paper by the same careful author.

As illustrating the practical use that can be made of infor-

[1] Proc. of the Ent. Soc. of Washington, Vol. i., pp. 118-36.

mation of this kind, Mr. Howard gives the following interesting illustration :

"The Hessian Fly has been very destructive for two years past in England, and the question has been, and it is an important one, whence did it come? Two important wheat-growing districts furnish England with much of its grain, *viz.*, North America and Russia. Now it happens that within a few months of each other Dr. Riley monographed the North American parasites of this insect, and Dr. Lindemann the Russian parasites. No accurate way of fixing the source of the English supply was found, until Dr. Riley, on his recent trip to England, discovered that the parasites there were identical with the Russian forms, and, with one exception, specifically distinct from the American forms; the exception belonging to the Russian fauna as well as to the American. America is thus relieved from the onus, which falls on Russian shoulders."

THE EPIPASCHIINAE OF NORTH AMERICA.—Under this title the Rev. Geo. D. Hulst[1] monographs the American representations of that small group of moths of which Epipasachia is the typical genus. As to the zoological position of this group, he looks upon the Epipaschiinae as either connecting the Phycitidae with the Pyralidinae, or as the ancestral and now nearly obsolete stem from which, in different directions, the other two have arisen. He enumerates eleven genera, represented by nineteen species.

A STUDY OF THE CYNIPIDAE.—There is on our table a valuable paper on this subject, from the Agricultural College of Michigan, by C. P. Gillette. The paper is based on collections made in the vicinity of Lansing. Mr. Gillette makes many observations on the previously described species, and gives descriptions, with figures, of the galls of several new ones. A list of thirty-four species of Galls Flies, taken in this locality, and of the parasites bred from them, is appended to the paper.

COLEOPTEROUS LARVÆ AND THEIR RELATIONS TO ADULTS.—The present paper is the first of a series of investigations which it is my purpose to carry on in connection with the larvæ and their relations to adults. My studies are confined to the post ovarian stages, and in this discussion the term larvæ is used to indicate such conditions only. It is my purpose to inquire into the origin of larval forms, both ancestral and acquired, and to compare the results of the study of

[1] Entomologica Americana, Vol. v., pp. 41-52, 61-76.

the larvæ of the various groups of the animal kingdom with the results of the study of adults. The following questions are among those for which an answer is sought:

To what extent are larval forms representatives of ancestral stages in the history of animals, and to what extent are they adaptations on the part of the larvæ, and therefore secondary?

How far is it possible to assign reasons for the larval departures from ancestral type?

Has the larval departure from an ancestral type, where it has taken place, occurred in numerous individuals simultaneously, or have the variations appeared in one individual and then been transmitted from it to a long line of posterity.

Have the forms and habits of the adult any direct influence on the larvæ, or those of the larvæ on the adult?

Are larvæ reliable as a basis of classification.

Are larvæ of any value in teaching the past history of animals?

Are larvæ of any value in teaching relations?

In cases where larvæ are departures from the ancestral type, and therefore secondary, are they of any value in teaching past history or present classifications?

Are larvæ more or less variable than adults?

Are adaptive larval characters inherited by succeeding larvæ?

The present paper is the result of the study of the larvæ of beetles, this group being first selected as showing the greatest amount of variation within a single order. As a starting point a Campodeoid form is taken. This is the most widely distributed, and has frequently been pointed out as the closest representative of the ancestral insect living at the present day. Starting with the Campodeoid type the different families of beetles have been studied as far as is possible with our present knowledge of them. The following are the most important points presented by the study of this group.

1. With the exception of the Campodeoid type of larvæ, which is found in a number of families, all beetle larvæ are secondary modifications which have been introduced during the larval life of the beetles, and have never been represented by any adult features. They are, therefore, of no value in teaching the history of beetles except in their larval stages. They do not represent ancestral stages. They may, however, and frequently do, teach relationship, since the presence of a similar larva may indicate a recent common ancestor.

2. It is possible, amid the immense variety of larvæ, to rec-

ognize four somewhat distinct types: the Campodeoid type, a type slightly and variously modified from the Campodeoid type, a Scarabid type, and a maggot-like type, like that of the weevils. In many cases it is possible to determine definitely the sort of conditions that have produced the present type.

3. The division of larvæ into types seems to have no relation to the classification of adult insects into sub-orders. None of the classifications of adult beetles into sub-orders runs in any way parallel to the natural division of larvæ into groups. The classification of the families of larvæ does, however, run parallel to the classification of the families of adults, so that it is usually possible to tell from the structure of a larva to what family it belongs. To this rule there are many exceptions, some of which are easily explained by differences in habit. The exceptions are most common in the low, degraded types of larvæ. The classification of families into sub-families and genera seems also as a rule to run parallel with the classification of adults, though there are many exceptions to this rule. The exceptions are such as to indicate that in some cases the adult classifications are at fault, and in other cases that there is really no parallel between the two stages. From this we can draw the conclusion that the present larval types of beetles are about as old as families but not much older.

4. The amount of departure from the primitive larval type that any family of beetles presents, is no indication of the position in the scale of classification that the adults should occupy. At least this is true if we accept the classsification of adults recognized at present by our entomologists.

5. Family characteristics are usually well marked in the larvæ. Generic characteristics are also usually quite definite; specific differences are usually very small and do not seem to be very constant.

6. There is in most cases an evident relation between the habits of the larvæ of a family and those of the adults. This indicates that the habits acquired by one stage have subsequently had their effect on the habits of the other stage. It seems probable that in beetles the larvæ has been the first to modify its habits, and that the adult has subsequently acquired habits related to it. The larval stage seems thus to be more important than the adult; at all events it is more thoroughly protected, and is the first to be adapted to suit its surroundings.

7. The larvæ of beetles are much more diversified than their adults.

8. Although habits and the conditions that surround the larvæ have been very important features in the production of the present larval forms, some other force has been at work in producing, or rather in retaining them. For we find a great variety of larvæ at the present time with almost identical habits. This other force is undoubtedly heredity, which has frequently proved stronger than the modifying effect of the environment.

9. Beetle larvæ cannot be classified by the same characteristics used in classifying adults. The shape of the antennæ has no significance in the classification of larvæ, since it is almost uniform throughout the order. The shape of the legs, the number of tarsi, the shape of the coxal cavities, are of not much more value. The mouth parts seem to be of a little more value, and are of far less value in classification than they are in the adults.

10. The mouth parts of beetle larvæ, even in the typical Campodeoid form, are not Campodeoid in type, but approximate rather closely to those of the adult beetles. No traceable similarity can be found between the mouth parts of any particular family of larvæ and those of the adults of the same family, beyond the general similarity sometimes produced by like habits. It is true, however, that the mouth parts of all beetle larvæ are more like those of adult beetles than they are like those of any other order of insects. This is probably an example of what Hyatt and Cope call concentration of development, and which is elsewhere called precocious inheritance. It is an instance where the characters of the adult have been impressed on the larval stages.

11. In beetle larvæ we have quite a number of cases in which a similar larval type has been acquired independently in two or more families.

The above conclusions apply only to the group of Coleoptera, and while some of them will doubtless be found equally true of other orders of insects, some of them are probably peculiar to beetles.

This paper was discussed by Professors Hyatt, Putnam, and Fernald, and by Messrs. Sargent and Jackson.—*H. W. Conn, in Proceedings of Boston Society of Natural History*, Vol. xxiv., December, 1888.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

NATURAL SCIENCE ASSOCIATION OF STATEN ISLAND, Nov. 10, 1888.—This being the annual meeting, officers for the ensuing year were elected as follows: President, L. P. Grata-

cap; Treasurer, Samuel Henshaw; Recording Secretary, K. B. Newel; Corresponding Secretary, Arthur Hollick; Curator, W. T. Davis.

December 8, 1888.—Mr. L. P. Gratacap read the following paper upon the "Relation Between the Growth and Form of Leaves:"

It is obvious that the form of leaves must be the resultant of rates of growth in various directions. That a simple leaf with a single midrib will assume such a mature form as will express the equilibrium of the growing impulse along two axes, a longitudinal and a lateral one, and that as this ratio varies in favor of the first or the second, the leaf becomes ovate, circular, broadly elliptical, etc., or lanceolate, linear and elongated. And secondarily, in the case of the simple leaf, the point of intersection of the axis will modify the final form. If the lateral axis is developed at an early stage in the elongation of the midrib we have ovate leaves, if at a point half way along its length elliptical, if at the distal extremity obovate. And in leaves of a complex structure, whether palmate, pinnate or numerously veined with woody and rigid vascular fibres, we can resolve the entire form into a group of simple forms, wherein we may study the related rates of development in lamination (formation of parenchyma), and in vasculation (formation of ribs, veins, etc.). In other words, the rapid movement forward of rib cells would appear to interfere with or prevent the making of the leaf lamina, and their slow movement to assist it. In a leaf with several ribs the slow progress of the rib-making permits the coalescence of the marginal tissues, and forms polygonal and crenate circular leaves, and also tends to introduce bifurcation and deliquescence of the original fibre bundles. In one where the extention of the ribs is rapid this coalescence is checked and the leaf is sinuate, lobed, irregular and pinnatified.

It is thus apparent that a determination of the *actual* rate of growth in leaves may throw some light or be useful in assisting speculation as to the origin of leaf forms And it is also apparent that there might be a condition of things exactly the reverse of our supposition given above, and yet produce the same result. That is, a linear leaf might be a, so to say, slowly made leaf as well as a quickly made leaf, if the movements of its parts maintain a ratio which gives extension in length and not in breadth. And in many cases of turgid and dense tissues in leaves this is probably so.

However the measurement of a number of leaf growths in-

cluding those of Morning-glory, Musk-melon, Water-melon, Maples, Magnolia. Peach, Japanese Quince, Five-finger, etc., made this year on Staten Island, do seem to show that the elongated leaves grow much the more rapidly, that the palmate and pinnate leaves stand next in order, and the circular and traverse leaves last. [A diagram was here presented showing these results, in part, with the rate per day of growth; also the slowly diminishing rate of growth of the leaf as it approached completion.]

Of course a number of considerations occur at once to modify the wholesale use of this conclusion. The relative size of the leaves compared should be similar, the condition or healthfulness of the plants alike, the nature of the plant tissue nearly the same, and the position and aspect of the leaves as regards favorable or unfavorable conditions for growth identical. The subject is suggestive and carefully followed up might lead to interesting results.

Mr. Arthur Hollick showed fossil leaf impressions in ferruginous sandstone, found near Arrochar station by Mr. Gilman S. Stanton. They are undoubtedly from the same formation as those from Tottenville (Cretaceous?) described in the Proceedings of December 8, 1883, and like them, were not in place where found, but occurred in Drift rocks. The specimens are too fragmentary for determination, but the fact of their discovery at this new locality is a matter of interest and is therefore placed upon record.

Specimens of bowlder clay from the same locality were also shown. It has been lately utilized for brick making. There is a fine exposure of modified drift overlaid by bowlder drift where the railroad has been cut through.

Dr. A. L. Carroll noted the discovery on Staten Island recently of *Bothriocephalus latus*—the first reported occurrence of this parasitic worm in America.

Specimens of the "Large Mocker Nut," (*Hicoria alba*, (L.) Britton, *var. maxima*, (Nutt.) Britton.) were presented—being an addition to the local flora. They were collected by Dr. Britton near Court House station.

Adjournment at ten o'clock.

February 9, 1889.—Mr. Charles W. Leng read a paper upon "The Buprestidae of Staten Island," illustrated by specimens of the species mentioned.

It is thought that the larvæ of many species take years to perfect their growth and an instance is recorded of a *Buprestis*

emerging from the wood of a desk that had been in use for 20 years. One of our commonest species, *Chrysobothris femorata* is, however, said by Packard to complete its transformations in twelve months, so the usual period is uncertain.

This insect is found every year in numbers on oaks and occasionally other trees. I took the greatest number about 1880, when Mr. Davis and I found a log near Silver Lake literally alive with them. They would take short flights and lighting on the log, hide in the crevices of its bark, which by their color and deep wrinkled furrows they simulate to a degree. Many other species have this restless habit of flying from place to place, and on the wing, look and buzz very like flies.

Two species of *Agrilus* are also abundant—*ruficollis* and *otiosus*—the first usually on wild blackberries and the second on a variety of young saplings. When the trees around Martling's Pond were cut down about three years ago, a growth of saplings sprang up on which the species of *Agrilus* were quite plentiful, and besides many *otiosus* an occasional *bilineatus* or *interruptus* was found.

I have never found any of our other species in great numbers. Of the *Anthaxia* all my specimens have come from a clump of wild cherry in the Clove Valley. *Chalcophora* is said to breed in pine, but a good deal of beating has yielded little. The species have been found washed upon the beach, and one specimen of *liberta* was taken by Mr. Davis flying at Watchogue. Two species of *Brachys* occur on the leaves of certain oaks, and I have found them in North Carolina in great numbers. Probably they will be found abundantly somewhere on Staten Island.

Chrysobothris azurea was a notable capture of 1886, and is everywhere counted a rare insect, but from May to July of that year it was plentiful on a species of dogwood in a thicket now burned over and turned into "Prohibition Park." The house, built, as I am told, for the dominie, stands just above where the first was taken. The beetles were very quick in their movements, and were captured by beating the trees over an umbrella, out of which they flew again as soon as they touched it. Several were observed resting on the main stems of the young trees, with the anterior legs extended, and the last ventral segment touching the bark, and they were probably females depositing their eggs. None have been found since 1886, nor have I been able to find the larvæ in the few trees that are left.

SCIENTIFIC NEWS.

The Trustees and Director of the Marine Biological Laboratory are now forming a permanent and somewhat extensive library for the use of workers at Wood's Hall. They have received already a gift of money sufficient to secure a very considerable nucleus of sets of biological journals and other standard works, to which they now desire to add also monographs and special contributions. As members of the Committee on the Library, we venture to ask that you will send to Dr. C. S. Minot, Harvard Medical School, Boston, Mass., any copies of your own publications, as well as any duplicates or other books, etc., which can be spared from your own collection of biological works, and which you are willing to present to the Laboratory. All works received will be promptly acknowledged and duly catalogued.

C. S. MINOT,
W. T. SEDGWICK, } *Committee.*
C. O. WHITMAN,

BOSTON, *Feb.* 23, 1889.

AUDUBON MONUMENT COMMITTEE.—About a year ago we called attention, by means of a circular letter, to a project for erecting a monument to the illustrious naturalist, JOHN JAMES AUDUBON, and requested contributions for that purpose, the expense of the design adopted being estimated at from $6,000 to $10,000.

We have now received about $1,000, and rather than obtain the remaining sum in New York City—as our plan has been from the first to make the Monument a national one—we again call your attention to the matter.

In order to encourage subscriptions, we have obtained reproductions from the best portrait of AUDUBON extant, and will send these, of a size suitable for framing, *to every contributor to the* fund of *one dollar or more.*

Remittances should be sent to the undersigned.—*N. L. Britton, Secretary and Treasurer, Columbia College, New York City.*

The Dutch East India government grants annually $30,000 for the support of the Botanical Garden and Laboratory at Breitenzorg, Java.

It is proposed in Norway to start another North pole expedition in 1890, under the leadership of Dr. Fridjof Nansen.

THE NAUTILUS, a sixteen-page illustrated, octavo, monthly journal of Conchology will take the place of the *Conchologist's Exchange* formerly published by Wm. D. Averell, and will be the successor of that paper.

It will be under the editorial management of Mr. Henry A. Pilsbry, Conservator of the Conchological Section of the Academy of Natural Sciences, and the successor of the late Mr. Tryon in the publication of *The Manual of Conchology.*— *William D. Averell, Mount Airy, Philadelphia, Pa.*

Prof. A. C. Haddon, whose journey to the Antipodes has already been noticed in these pages, is engaged almost as much in anthropological as in zoological investigations. He was recently in Thursday Island, where he finds that the young men know nothing of ancestral conditions, and if observations be not made soon with the aid of the old men it will soon be too late. He will later go to the Louisiades and the neighboring islands, and then again to New Guinea. He will probably stop but a short time in Ceylon.

At a recent meeting of the Academy of Sciences of Paris, Prince Albert of Monaco drew attention to the fact that vessels running short of provisions might obtain food sufficient to support life indefinitely if provided with apparatus for collecting the surface swimming forms.

Dr. Heinrich Alexander Pagenstecher, director of the Museum at Hamburg, died January 5, 1889, of heart disease. Dr. Pagenstecher was long professor of zoology at Heidelberg, and while there wrote his four volumed "Allgemeine Zoologie." He was sixty-three years of age.

Dr. Whitman's *Journal of Morphology* receives, at the hands of Mr. G. P. Howes, well deserved praise in *Nature* for January 10.

M. G. Meninghini, professor of geology at Pisa since 1849, died January 29, aged seventy-eight.

Charles Brogniart has recently found fossil cockroaches of the family Mylacridæ in the Commentry formations of France.